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AMERICAN JOURNAL *of* PHARMACY

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A Record of the Progress of Pharmacy and the Allied Sciences

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THE AMERICAN
JOURNAL OF PHARMACY

VOL. 95. SEPTEMBER, 1923. NO. 9.

EDITORIAL

"BROWSING" IN OLD BOOKS.

To the discriminating reader there is oftentimes a sedulous charm in leaving awhile the things that are too immediate and seeking a taste of mellowed vintages preserved between the leather covers of books of other days. "Browsing" in old books is in truth a rare diversion not much unlike the joy that comes of sitting in the evening glow or out before the campfire's dying embers—alone—and picking from a well-lived past the memories worth recalling; and everlastingly more companionable than well-intentioned tomorrows are these memories of yesterdays clean-spent. Like, then, the lifting of the joys of yesterday to the stage of today's performance is this "browsing" in old brown books.

And what a word is "browsing"—how delightfully it fits into its descriptive tenantry here. Webster calls it "Feeding on young and tender greenery." How the very word paints pictures full of placid, restful colors. Cows, contented, on a balmy springtime morning, chewing gravely in the willow shadows—and even in the stolid swinging of their busy jaws one reads the story of an appetite well served. Green twigs, tender young clover and blades of grass unscorched by torrid sun—to cows—a rare Elysian diet—and this forsooth is "browsing." No wonder then that there is keen delight in this word as applied to old books. Not, indeed, that the simile fits in its freshness—here are no succulent stems of the springtime, here are no tender young twigs—for the years have long since claimed the verdant newness of the nigh forgotten books that hide in dusty garrets and shed their powdery bark at every gentle touch. Only the new, giddy in red and gold and blue, are stored where glass will hold no secrets—but up in the attic, hidden from view, repose my old brown books. Yet, evenings when the sameness, the stiffness of

new books annoy, I turn to the old for comfort. Here is *naivete* and charm, lucid expression, and sweet English that talks as from a breathing thing.

And as I read the mottled, coppery pages I think of proud authors, long since returned to silent, inorganic dust, whose tongues still wag in printed converse. How like the lotus bud, whose precious scent preserved in Tutenkhamen's heavenward unguents, outlasted long the flower's fragile beauty.

True, the old brown book has often lost its poignant message. To us, this day, the thought it bears is often commonplace and dull. But in its day it claimed esteem and sounded clarion notes to tell of great inventions. From the chiselled rock of the first awakening, through the hand-marked bricks of baked clay, to scrolls of imperishable parchment illumined with the lifelong love-labors of ascetic monks, then the crude impressioned print of Caxton's age, and on to our brilliant times, these written records of the hurrying scribes tell their own tale of steady human progress. How well they mark the music to Tennyson's thoughtful rhyme——

> Yet I doubt not through the ages one increasing purpose runs,
> And the thoughts of men are widened with the process of the suns.

Browsing in old books with candor like this——

> "Dr. Thompson *pitches* on the number 3.5 for the atom of manganese, from the researches of John and Berzelius. The confidence due his authority in this case may be judged by the following narrative: 'Dr. John acknowledges that his analysis of these oxides is by no means dependable and Berzelius' statement is confessedly more theory than experiment.' Science wants sounder foundations than such guesswork and small talk."—(*Ure's Chemical Dictionary,* about 1820.)

Old books with a flaming stream of words like this——

> "The rivers were dried up and liquid ore supplied their burning channels—the clouds were turned to hungry fire and shot through the astonished skies. The air was flame and breathing was no more. The firmament was melted down and rained its streaming sulphur upon a prostrate globe."—(*Day of Judgment.*)

Old books with charming bits of nature revelations like this——

> "It has, indeed, been asserted that the ground squirrel, previous to burying in the earth its winter stores, takes the precaution of depriving each kernel of its germe that it may not sprout and lose its pretty taste." —(*Barton's Flora.*)

What an interesting fancy, or perhaps fact, in the proof of reason in animals other than man!

Yes, indeed, there is a rare enjoyment in the genial, garrulous comradeship of the old brown book——

> "That love of learning, the sequestered nooks
> And all the sweet serenity of books."

I. G.

SELECTED EDITORIAL.

OBLIGATING STUDENTS OF PHARMACY.

A circular letter sent out by the Committee on Admission of the Philadelphia College of Pharmacy to prospective students marks a new departure in the method of enrollment. This is to the effect that hereafter applicants for admission as students will be required to subscribe to a code of ethics governing the principles on which they pledge themselves to engage in their profession. Dean LaWall, in explanation of this departure, points out that pharmacists feel that the student should pledge himself before, not after, taking his training course. As he puts it, it is better for pharmacy students to be familiar at the beginning of their college courses with the principles which should guide them in the future conduct of their profession.

Of course, as every pharmacist knows, it has been customary to require the candidates for a degree in medicine to subscribe to the Hippocratic oath at the time of graduation, this obligation pledging the newly fledged physicians to follow certain ethical principles and rules of conduct in their contact with the sick and with each other. But if the requirement which is to be exacted by the Philadelphia institution is to obtain, the pharmacist's obligation will really become operative and binding the moment he en-

rolls as a student. If he takes the pledge, as it is expected he will do, if he wants to study pharmacy, he cannot well say in after years that the difficulties and drawbacks of the calling were not made known to him; in other words, he enters the profession with his eyes open, and it remains for him to make good his pledge by rendering the highest type of service to the public according to the code of ethics which forms the foundation of his obligation.

The code of ethics employed by the Philadelphia college is that adopted by the American Pharmaceutical Association at its meeting last year in Cleveland, which certainly contains nothing repugnant to individual freedom, or to the duty one owes to himself or his fellowmen. If the future pharmacist can be made to understand what real pharmacy expects of him, both his profession and the public will be the gainers thereby. In fact, if all pharmacists will follow the principles set forth in the A. Ph. A. code of ethics, pharmacy in general would greatly profit and have more to its credit.—*The Pharmaceutical Era.*

ORIGINAL ARTICLES

LIGATURES AND SUTURES.

By Dr. Fred B. Kilmer, Ph. M.;
G. S. Mathey, Ph. G., Ch. G., B. C.,
and H. J. Dobbs.

[This is the first of a series of papers discussing the subject of Ligatures and Sutures from a pharmaceutical standpoint. While in many respects elementary and incomplete, it is hoped that its publication may assist the pharmacist in handling this class of material.]

The fate of the patient, the operator's reputation and the success or lack of success in a surgical operation often hang upon the integrity of a stitch or a knot made with a minute bit of cord.

The ligature or suture material used by a surgeon is one of the most complex and interesting substances in his whole armamentarium. The preparation, handling and dispensing, the office or function of these substances lead into the realms of microbiology, physics and physiological chemistry—into the processes of wound repair, on to the threshold of life itself.

With a reliance upon the ligature and suture—cord of life—the surgeon has become brave and even audacious. In part by their use we have, in a generation, witnessed the birth and growth of a new surgery—a daughter of science and art—that has saved mankind incalculable suffering, and, yes, helped to prolong the span of life. Operations formerly deadly are now safe; operations formerly thought to be impossible are now of daily occurrence.

It has been tersely stated that nowadays the surgeon opens and closes the abdomen with as much freedom as a tailor slits and closes a seam. Without hesitancy he will suture the heart, the brain, the lungs—no organ and no tissue is outside his realm.

Ambrose Pare demonstrating the use of the ligature (16th Century) after the celebrated painting.

Historical.

A few skulls and bones dug here and there out of the earth strata, arrowheads and flint tools picked up over the surface, crude pictures scratched on the walls of a cave, tell us the story of men who lived far back in the long stretches of time that preceded history.

Among the first things which man made were sharp-edged tools of flint or bone. With these came cuts and wounds. Hence, five hundred thousand or a million years ago we have the beginnings of surgery. The bow used in the hunt carried

a cord. Tubal-cain, of the line of Adam, made musical strings, and fashioned bone needles with the threads of sinews. Here was the need and the material with which to tie or stitch a wound.

In primal man we note the intense, widespread and lasting instinct prevailing today among savage and civilized nations—the altruistic instinct to rescue and help the individual imperiled.

Out of this has come medicine and surgery. The ligature has appeared, disappeared and reappeared many times in written history. We meet it applied to bleeding vessels at least 1500 years before Christ. It is mentioned by Celsus and Galen. In the Christian Era we have a famous work of art exhibiting Paré, the celebrated French surgeon of the sixteenth century, demonstrating the use of the ligature for tying. It reappears again in the eighteenth century. In our own country Physick was one of the early users of animal sutures made of dogskin and chamois. Agnew and McDowell used ligatures both for tying and for stitching.

The widespread use of the ligature and suture in modern times begins with the classic work of Sir Joseph Lister, which led up to the antiseptic treatment of wounds, the absorption of buried ligatures, the use of twisted strips of the peritoneum of the ox, and the violin string. The introduction of the use of absorbable animal material for ligatures and sutures by Lister made a profound and lasting impression upon the practice of surgery.

Ligatures and Sutures in Pharmacy.

In pharmacy, ligatures and sutures in too great part are unknown material. They are not recognized in the textbooks; few of the colleges give them a place in their curriculum; pharmaceutical research workers have ignored them.

In the evolution of surgery the use of ligatures was at first largely confined to hospital practice, and the hospital pharmacist prepared the material as needed. There have been recorded some two hundred and fifty formulas and methods which have been used in hospitals during the last generation for preparing ligatures, and in turn each formula has been abandoned and another substituted. Quite early came the classic work of

Charles Rice, in his capacity of hospital pharmacist at Bellevue. The profession is still striving for a more perfect product. Unfortunately they receive little or no aid from the pharmacist.

No substance in the surgeon's armamentarium is more important for the success of an operation than is the suture material. Be the amount which he uses great or small, there is nothing he is more anxious to have just right. And it is here that the trained mind of the pharmacist is needed, and it is here that it often fails.

Fig. A—Cross-section of intestines of sheep, showing outer muscular layers and mucous layers in the central portion. In the preparation of catgut all except the submucous coat is removed.

In general, the pharmacist has a greater knowledge of Epsom salt or a hot-water bottle than he has of ligature material. Sorrowfully, we are forced to admit our lack of comprehension of many of the substances used for ligatures and sutures. Anatomy and physiology have so far contributed but little; the medical college curriculum is so crowded that these substances receive scant attention, they are usually mentioned by name, and it goes at that. The operating surgeon may know the size or the kind that he hopes will give results, but his knowledge is not deep or accurate. Medical literature upon the subject is prolific in quantity, but is too often empirical, reiterative and redundant with incomplete and inconclusive statements.

The report of a recent meeting of hospital workers, where the subject was discussed at considerable length, was an amusing but sad commentary upon our insight as to the true nature

of such an important material. What we do not know looms strong, and is vital, in comparison with our real perception.

An admission of our imperfect knowledge of the subject offers a warrant and a point of beginning for this series of studies.

A Few Definitions.

In approaching this subject an explanation of certain terms may be necessary for beginners. Those given are not intended to be complete or cyclopedic.

The terms "ligature" and "suture" are often used as of equivalent meaning. The difference between the two is distinct, and should be emphasized.

Ligature, when used as a noun, means the thread or cord with which an artery or vein is tied to prevent or arrest hemorrhage. It is also applied to a cord, thread, or wire used to remove tumors, etc. When used as a verb it means to tie.

Suture, when used as a verb, means to stitch or to sew. In surgery it means the stitching together of the edges or lips of a wound to effect union. Suture material is used in sewing together tissues, blood vessels, nerves, bones, etc., until normal union is performed by Nature. The same material, however, is used both for sutures and for ligatures.

Material used for ligatures and sutures is divided into two general classes, *viz.*, the "absorbable" and the "non-absorbable."

Absorbable Sutures.

Absorbable sutures (or ligatures) are those which, during the healing process of wounds, are absorbed by the tissues in which they are imbedded. Those most commonly used are catgut and kangaroo tendon. Other materials have been suggested, such as the tendons of the ox, deer, reindeer, rat, muskrat, the narwhal, heron, crane, and various birds and animals. With the exception however, of the well-known catgut and the kangaroo tendon, the materials named have not been generally adopted, principally for the reason that they are irregular in size and difficult to procure.

Animal tendons consist of layers of longitudinal fibres, which are split to form a suture of suitable size. Animal tendons are readily absorbed. The tendon of the kangaroo, or

wallaby, is the best known and most-used of all animal tendons. For use as sutures or ligatures the tail tendons are split into rather irregular sizes.

The claim is made for animal tendons that owing to their longitudinal fibres they absorb more slowly and more perfectly than the spiral strands of catgut.

Kangaroo tendons cannot be accurately gauged as to size and length. They are roughly divided into fine, medium and coarse as to size, with an average length of twelve inches.

Kangaroo tendon suffers deterioration by steam sterilization, boiling in water, and by heat processes generally. It is used mainly by specialists.

Surgical catgut is descended from the musical string, and it is believed that the ancient makers of these strings employed the intestines of the cat and other animals.

The term "catgut" is generally explained upon the basis that the word itself was originally derived from "kitgut" or "kitstring," meaning a fiddle, and this term has become confused with "kit," meaning a little cat. Modern catgut is really sheep gut.

Catgut, as made from sheep intestine, is a ribbon-like material which can be twisted into a cord, presenting at once the most acceptable type of absorbable suture. (Catgut will be the subject of a subsequent study.)

Absorbable suture material can be treated so as to retard absorption, *e. g.*, hardened, chromic, or tanned catgut.

Non-Absorbable Sutures.

Certain suture materials are in use which are practically non-absorbable and, as such, remain in the tissues for an indefinite length of time. Examples of such substances are silk, silkworm-gut, linen, horsehair, and the various metallic wires, such as silver, copper, aluminum, bronze, etc. It may be noted that in the course of time (sometimes years) some of these so-called "non-absorbable" sutures disintegrate and disappear, but they are not absorbed during the process of wound-healing. This, however, does not happen in the case of hardened catgut, which disappears within varying periods.

Silk Sutures.

The silk fibre consists of a continuous thread spun by that species of caterpillar known as the silkworm. The so-called Mulberry Silkworm, cultivated in many countries, produces the bulk of the silk of the market.

The eggs from which the silkworm is produced are laid by a scale-winged insect of the genus Bombyx. The growth and development of the worm is very rapid. When the worm reaches maturity it exudes a viscous fluid that forms, on contact with air, a continuous thread with which it spins a cocoon. After finishing the winding of its cocoon, the enclosed silkworm passes into a chrysalis or pupa. From this condition it eventually emerges as a butterfly. In the production of silk for commercial purposes, the development of the pupa is arrested at a certain stage by subjection to heat, which kills it.

The silk fibre is obtained by unreeling the cocoon, and this process produces what is known as raw silk. The short tangled fibres from the exterior of the cocoon are the source of floss silk, from which, in turn, spun silk is made.

Before being manufactured into textiles, the raw silk thread is subjected to several processes, which give the fabrics into which it is subsequently woven their soft texture and glossy appearance.

The chief chemical constituents of silk consist of sericin, fibroin, resins, fats and mineral matter. Fibroin, which constitutes the core or major portion of the fibre, is a proteid, analogous to that contained in wool. Sericin is an altered form of fibroin; it is the so-called silk glue which forms the outer coating of the fibre. Silk is notable for its tensile strength, which is stated to be equal to that of an iron wire of equivalent diameter. It is very elastic. Boiled-off silk, and silk weighted with fillers to lend luster, are impaired both as to strength and elasticity.

Silk will withstand a temperature of 110° C. without decomposition. It is dissolved by strong hot alkalies, and by concentrated sulphuric and hydrochloric acid. Silk readily absorbs coloring matter and dyes.

Twisted and Braided Silk.

Under the microscope true silk is a structureless thread, the so-called "wild" silks being made up of bundles of delicate fi-

brille. The threads, as spun by the silkworm, are twisted and braided together to form what are known technically as "twisted silk" and "braided silk," respectively. Raw silk is cream or orange color. As found in the market, however, it is white, due to scouring and bleaching.

Many surgeons prefer silk sutures that have been dyed black, this color being more readily perceptible in the wound cavity or tissues. Silk of this type is known as "iron dyed."

Silkworm-Gut.

Here again we have a misnamed substance. Silkworm-gut is not made from the intestines of the silkworm, but from silk fluid secreted by the silkworm. The term "gut" was attached to it by an English clockmaker who confused it with the animal strings upon which the weights of clocks were suspended.

Silkworm-gut is made direct from the silkworm before it forms its cocoon. The silkworm is killed by dipping it into acetic acid. Its pouches are then opened by hand and their thick liquid contents drawn out between the fingers of the operator. Silkworm-gut is essentially unspun silk. The bulk of this material is supplied from the province of Murcia, Spain.

Silkworm-gut is a cream-white, smooth, lustrous material, but it is quite stiff, and is usually soaked in warm or hot water before attempting to tie it. This procedure has a tendency to prevent splitting. The shortness of the strand of silkworm-gut limits its field of usefulness. The average length runs from twelve to fourteen inches; the longest length ever produced is eighteen inches. There is no way in which this difficulty can be overcome, and neither can there be any accurate assortment as to sizes.

In surgery silkworm-gut is used principally for suturing the skin.

A recent innovation is a so-called "artificial silkworm-gut," which emanates from Japan. While its manufacture is a secret, it is said to be made by taking a strand of twisted silk and coating it with a solution of silk. This form of suture is very pliable, but not as strong as the natural product. It can be produced in long lengths and many sizes. It likewise is used primarily as a skin suture.

Linen Sutures.

These are literally linen thread, and ordinarily are used in their original grayish-white form. Some operators, however, prefer the black linen cord.

A form known as "Pagenstecher's Linen" is a linen thread impregnated with celluloid. This is to overcome capillarity and thus prevent infection from being carried into the wound by the strand. The coating increases the tensile strength and overcomes any tendency to irritate. It also obviates the troublesome snarling and kinking occasionally occurring in silk strands. This form is but little used.

Linen thread, black or coated with paraffin or with beeswax, has some use.

Horsehair Sutures.

These sutures are taken from the tail of the horse, and are prepared for surgical uses as follows: They are first subjected to a thorough cleansing with boiling water and soap, to remove the gross dirt. This is followed by repeated washing and sterilizing in hot water and steam. Owing to the liability of the presence of tetanus and other organisms in horsehair, a thorough sterilization is required.

No particular gradation of sizes for horsehair sutures can be made. They are usually supplied in approximately uniform lengths, packed in tubes or envelopes, and sterilized within the container.

Horsehair is a fine, elastic substance with very little tensile strength. It is used chiefly for the suturing of the skin, particularly about the face, neck and lips, and leaves but little scar or cicatrix.

Wire Sutures.

Silver wire sutures are made of drawn wire of silver mixed with copper. Silver wire was used for ligature and suture work before the advent of catgut. It was supposed to have an antiseptic effect in the wound. As it cannot be knotted, it is fastened by twisting the ends. The main use for silver wire at present is for suturing the bones.

Wire sutures have been made of other metals, such as aluminum, bronze, etc.; at present, however, they are but little used.

A noteworthy feature of metallic sutures is that in the course of time they disintegrate and disappear in the tissues.

Making Surgical Catgut.

In the minds of many people catgut is—just catgut. It is accepted as a necessary surgical adjunct, or a means to an end, and all too often does not receive that degree of careful study that its important relation to surgical procedure warrants.

The pharmacist who is familiar with the mysteries of the operating room will recall a time during that successful struggle with death when the surgeon requests a "ligature please!" Much at this time depends upon the surgical nurse whose years of experience and association have enabled her to anticipate his requirements.

Away from the operating room and its attendant cares, the surgeon frequently desires, and may well be encouraged, to discuss his problems with his pharmacist friend, to exchange views and intelligently analyze certain manifested phenomena.

To fully appreciate catgut one must familiarize himself, not alone with its use, its chemical makeup, or its relation to the tissues, but also with the processes involved in its manufacture. This may throw some light upon ultimate results, and serve to explain many mysterious sequelæ.

Catgut is the product of the sheep's intestines. In general the intestine is made up of four distinct layers (see Fig. A), and might well be compared to a common garden hose. Over the whole is spread a serous membrane, which, however, does not concern us here. There is a central layer of soft tissue, called the mucous layer, which is capable of absorbing the fluid food content of the stomach as it is delivered to the intestine. Around this inner layer is the so-called submucous layer, and over this are two muscular layers, one with lengthwise fibres and one in which they run crosswise, or around the intestine. All this tends to produce a strong, hose-like tube, with great elastic properties in both directions.

The study of the making of the intestines of sheep into catgut is interesting. The intestines of the sheep, which are from sixty to seventy feet in length, vary somewhat, not alone in individual sheep, but also the different species and country of origin.

In structure they are much the same as those of the human being. For surgical purposes, and with a view to obtaining the very finest product, only about one-third of the total length

can be utilized. This portion, about twenty-four feet long, is known as the "narrow end," since it commences at the stomach. The portion that gradually widens out, and eventually connects with the large intestine, is disposed of in other quarters and usually converted into sausage casings.

Putrefaction very quickly manifests itself unless the intestines are handled almost immediately after their removal from the animal. Thus it will be seen how necessary it is that the catgut laboratory be located in proximity to the original source of supply.

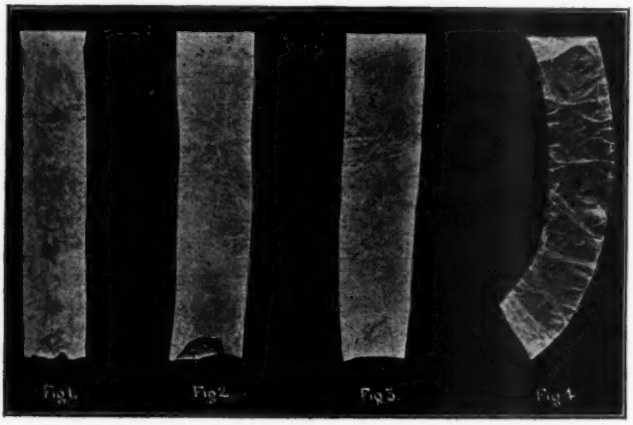

Fig. 1—Intestines as taken from the sheep, containing feces and fat nodules.
Fig. 2—Whole gut after first stripping, which is the initial stage in removing foreign matter.
Fig. 3—Whole gut after further stripping—here the gut is nearing the state or "condition" for manipulating.
Fig. 4—"Conditioned" gut—the tissue has now lost its original light pink color and is ready for splitting.

When the narrow ends of gut are received they contain much fecal mass and fat nodules (Fig. 1), which must be promptly removed in order to prevent decomposition. This procedure, which is the initial stage of preparation, is known throughout the trade as "stripping."

Stripping, like so many of the twenty-four subsequent operations previous to sterilization, is performed by hand. In the main it consists of drawing the intestines through the closed hand, which squeezing pressure served to remove the gross dirt (Fig. 2), and in this state they are transferred to barrels of

The next step is that known as "conditioning," to effect which the stripping process is similarly repeated for several days, each daily manipulation and transference to other tubs of clean water helping to still further remove the dirt and fecal residue (Fig. 3), until the gut finally loses its original light pink color and reaches the proper state of condition.

A very watchful eye has to be kept over the guts while passing through these stages, as decomposition must be defeated. For this reason a Sunday or a holiday is not allowed to pass without the customary inspection and handling.

Fig. 5—Showing the thread or membrane which is adherent to the "smooth side" of the intestine—this thread must be removed before the tissue can be used for the purpose of making catgut.

Fig. 6—The intestine reduced to its submucous layer—this also illustrates the natural curve of the intestine—the "smooth-side" follows the outer curve and is therefore a trifle longer than the "rough (or mesenteric) side" which follows the shorter curve.

Fig. 7—The submucous structure after having undergone a bleaching process.

Fig. 8—Whole gut having undergone all the processes including a treatment to impart suppleness.

The conditioned guts (Fig. 4), are now transferred to tanks containing a weak alkaline solution and placed in front of the splitters' tables. The guts are then individually removed by hand and one end placed over a curved tapering peg. This peg has a vertical razor-edge knife firmly fixed in the end nearest to the operator. The gut is then pulled over the peg, against the knife, and is thus split into two parts.

The natural twist of the intestine (Fig. 6), automatically adjusts itself to the curved splitting peg, with the result that

one-half of the intestine is pulled to the right of the blade, and the other to the left. Thus will be accumulated on one side of the operator a pile of "rough-side" half-guts (Fig. 10) (termed "rough" on account of their being the mesenteric surface), and on the other, a pile of "smooth-side" half-guts (Fig. 11).

The smooth-sides, which are a trifle longer, due to the fact that they are that half of the gut that follows the outside (or longer) curve, have a narrow thread of tissue (or membrane) adhering to the entire length (Fig. 5).

Threading (the removal of the threads) is a difficult undertaking, requiring considerable manual dexterity acquired only through years of constant practice.

Twisting or spinning of the strips of tissue to form a cord or thread.

We now have two piles of split gut—the "rough-sides" that needed no threading, and the "smooth-sides" with the threads removed.

The next step is to take these half-guts and subject them to further treatment with a view to separating and removing the worthless intestinal layers.

The smooth-side half-guts are thrown over a wide board standing on end, so that while the greater length lies on one side, a few inches hang over the other. These few inches are scraped with a dull-edged instrument until the threads have been sufficiently loosened; thereafter the loose thread is pulled back over the top of the board and drawn throughout the entire length of the gut.

Sheep's intestines, like all others of the animal kingdom, are constructed of four distinct coats—the inside, or mucous layer with its numerous villi or spongy masses of glandular and epithelial cells, and the outside, or serous coat, while between them will be found the muscularis and submucous connective tissue.

Besides the fact that the mucous coat can serve no useful purpose, greater tendency to decomposition would exist were it allowed to remain. Therefore it becomes necessary to eliminate this part of the intestinal structure, and this with other objections, such as the brittleness of the serous coat, gradually reduces the available material to the submucous connective tissue, and it is this, and this alone, from which the best surgical catgut is manufactured.

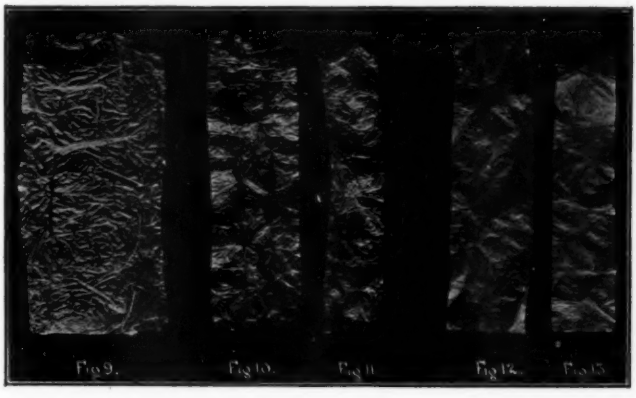

Fig. 9—The gut as described in Fig. 7 has here been split open.
Fig. 10—Illustrating the "rough-side" of the split intestine before undergoing the final process.
Fig. 11—The "smooth-side" of the split intestine before undergoing the final process.
Fig. 12—The finished "rough-side" strip after all processes including the suppleness treatment—ready for spinning.
Fig. 13—The finished "smooth-side" strip after all processes including the suppleness treatment—ready for spinning.

With a view to loosening the various intestinal coats it is necessary to produce a reaction similar to that manifested by nature. Constant experimentation has demonstrated a method which brings about an ideal condition.

The removal of the useless tissue is a delicate operation, requiring most accurately adjusted machinery, and above all

else the exercise of skilful workmanship. The various processes are therefore in the following sequence:

1. *Cleaning.*—The half-guts are drawn between a revolving drum and a rapidly turning paddle wheel in the presence of a constant stream of water, serving to wash away the spongy mass of mucous tissue as it is brushed off.

2. *Scratching.*—A scraping process that is conducted by hand. Here the mucous-free strips are hung over a blunt hook and the hand is drawn with a downward sweeping motion so that the gut is allowed to pass between the fingers.

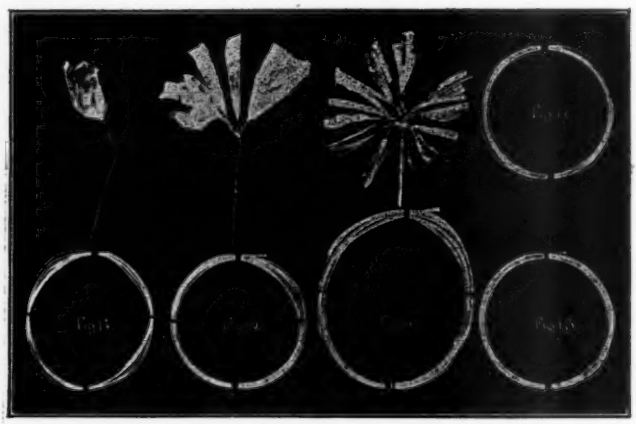

Fig. 14—One strip of "smooth-side" tissue twisted into a strand of fine catgut.
Fig. 15—Four strips twisted to form a larger strand of catgut.
Fig. 16—Showing the sixteen individual strips which compose a strand of catgut this size.
Fig. 17—A coil of unpolished catgut.
Fig. 18—A coil of polished catgut ready for sterilization.

3. *Sliming.*—This is a long process necessitating considerable able vigilance. The cleaned and scratched strips are now placed in a machine that repeatedly draws them between a pair of blunt-edged scrapers and a heavy weight that serves to press the tissue against the blunt edges.

This concludes a two-weeks treatment completing the removal of the serous, mucous and muscular layers, leaving only the submucous connective tissue, which alone should be used for the manufacture of surgical catgut.

The next step is the cutting of the strips into proper lengths and looping the ends to facilitate spinning at a later

stage. However, before spinning they may undergo a bleaching process (Fig. 7), while a still further step is a treatment serving to impart greater suppleness to the final product (Fig. 8.)

While still in a moist state several of these finished strips are twisted or spun together, serving to form one solid strand (Figs. 14, 15, 16), after which they are attached to pegs and stretched between posts until dry.

The dry, rough strand of catgut (Fig. 17) is now removed to a polishing chamber where the process of polishing is conducted by hand and by experts, upon whose delicacy of touch largely depends the integrity of the finished strand (Fig. 18).

After polishing they are again washed, dried, gauged and made into coils in preparation for the commencement of their second long journey, namely that of sterilization.

LABORATORY OF JOHNSON & JOHNSON,
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THE ASSAY OF MONO-SODIUM PHOSPHATE AND PHOSPHORIC ACID.

By Frank X. Moerk and Edward J. Hughes.*

Mono-Sodium Phosphate.

This salt, generally labeled "Sodium Acid Phosphate Monobasic," was first used commercially in the manufacture of a baking powder because of its property of liberating carbon dioxide from sodium bicarbonate; later this same property led to the manufacture of an effervescent sodium phosphate; its more pleasant taste is causing it to replace to an increasing extent the ordinary sodium phosphate or disodium phosphate which has been official for many years.

Proposed for recognition in the current revision of the U. S. P. its acceptance makes a method of assay of importance.

The salt has the formula $NaH_2PO_4H_2O$ and is made by the addition of phosphoric acid to a solution of disodium phosphate until the mixture no longer precipitates with barium chloride after concentration.

*Chemical Laboratories of the Philadelphia College of Pharmacy and Science, July, 1923.

The assay should therefore include the determination of H_2O and of NaH_2PO_4, also of H_3PO_4 and of Na_2HPO_4 in case either of the latter two were used in excess in the manufacture of the salt.

H_2O. Mono-sodium Phosphate at 100° C. loses its water of crystallization (13.05%), at 200° C. it loses the equivalent of another half molecule of water (19.58%) becoming $Na_2H_2P_2O_7$ and at 204° C. or higher (to fusion) it yields $NaPO_3$ with a total loss of 26.10% H_2O. Another reference gives at 200° C. the loss of two molecules of water or 26.10%.

H_3PO_4 and Na_2HPO_4. In the AMERICAN JOURNAL OF PHARMACY, 1922, pages 650-655, the writers published two methods for the assay of these chemicals: one based upon the use of methyl-red in presence of excess of $AgNO_3$ which is suitable for the assay of phosphoric acid and of disodium and mono-sodium phosphate because the acid and the acid phosphates form Ag_3PO_4 with liberation of an equivalent quantity of HNO_3 which is really titrated but this method is not suitable for trisodium phosphate as no acid is liberated, the mixture showing a neutral reaction; the other method based upon the use of a mixed methyl-orange and indigo-carmine indicator which will show with both H_3PO_4 and Na_2HPO_4 the formation of mono-sodium phosphate as the end product, the H_3PO_4, however, requiring the presence of a certain amount of NaCl depending upon the final volume of the titrated solution; this method can also be made suitable for tri-sodium phosphate, because of its alkaline reaction not only to methyl-orange but also to phenolphthalein.

NaH_2PO_4. For reasons just stated the methyl-red in presence of $AgNO_3$ method can be used whilst the mixed indicator method, giving NaH_2PO_4 as the end product, cannot be used. A combination of indigo-carmine and phenolphthalein suggested itself but was found unsatisfactory because the solution had to be made alkaline to produce the color to be matched and the small amount of alkali necessary was sufficient to cause destruction of the indigo-carmine. In a paper presented this year to the Pennsylvania Pharmaceutical Association the replacement of indigo-carmine by a more suitable blue color was attempted, but of the large number of colors tested only two were found which were not destroyed by alkali, the two dyes, made by the Cassella Co., of Frankfurt, have been in the laboratory cabinet for twenty years and

are labeled Indigo N and Indigo SGN; unfortunately nothing could be ascertained as to the composition of these specimens nor where more could be procured; titrated solutions could stand for a week or more without losing the green color due to excess of alkali; in fact, it was possible to titrate a 5 per cent. NaOH solution with acid without destruction of these samples of indigo.

Experiments were next made with phenolphthalein as indicator and it was soon found that NaCl was necessary for successful titrations, also that carbonates in the alkali V. S. gave rise to discrepancies. In making titrations with a specimen of NaH_2PO_4 in the presence of NaCl a precipitate having the characteristics of $Ca_3(PO_4)_2$ appeared towards the end of the titration and this was traced to the NaCl which was found to contain calcium although labeled C.P.; in these titrations 12.4 cc. NaOH V.S. were required, whereas with a new NaCl solution, free from calcium, only 11.5 cc. were required, the 0.9 cc. being used to change $CaHPO_4$ into $Ca_3(PO_4)_2$.

NaOH V.S., free from carbonate, was made by adding a slight excess of $Ba(NO_3)_2$ to the NaOH solution and filtering; this solution should be standardized with HCl or HNO_3 V.S. to avoid the formation of a precipitate, preference was given to HNO_3, as this also enabled the standardization of the NaOH V.S. in presence of $AgNO_3$ with methyl-red indicator without the formation of a precipitate

Assay With Methyl Red Indicator.

To 40 cc. of deci-normal $AgNO_3$ V.S., or an equivalent quantity of any other $AgNO_3$ solution, add 0.2 cc. methyl-red and sufficient NaOH V.S. to just change the red color to yellow, next add 10 cc. mono-sodium phosphate solution (about 0.2 gm.) and titrate with deci-normal NaOH V.S. (free from carbonate) until the supernatant liquid changes from pink to yellow (a drop of deci-normal acid V.S. should restore the pink color).

The reactions involved may be represented:

$$NaH_2PO_4 + 3AgNO_3 + 2NaOH = Ag_3PO_4 + 3NaNO_3 + 2H_2O.$$

$2NaOH$ therefore equal $1NaH_2PO_4$.

Assay With Phenolphthalein Indicator.

To 100 cc. 10 per cent. NaCl* solution (free from calcium) add 0.2 cc. phenolphthalein indicator and sufficient NaOH V.S. (free from carbonate) until a distinct red color is produced; divide the solution into two equal portions, placing these portions in beakers of the same internal diameter. To one of these portions add 10 cc. mono-sodium phosphate solution (about 0.2 gm.) and titrate with deci-normal NaOH V.S. (free from carbonate) until the color matches that of the reserved portion.

The reaction involved:

$$NaH_2PO_4 + NaOH = Na_2HPO_4 + H_2O.$$

1NaOH therefore equals $1NaH_2PO_4$.

Three samples of mono-sodium phosphate were examined, "A" from a western and "B_1" and "B_2" from an eastern firm. "A" and "B_1" were in form of dry, coarsely crystalline particles; "B_2" appeared moist and adhered to the container; "A" on inspection showed some particles more opaque than others and in the first assays, using different weights for analysis gave varying results, after powdering the sample uniform results were obtained.

Before giving the data which covers the standardization of the volumetric solutions used in the following determinations it may be well to recall that 0.2 cc. of any specified indicator was used and the indicator brought to a definite color or tint by adding either an acid or an alkaline V.S. and reserving a portion of this prepared indicator solution for comparison; in the case of methyl-red where there is a sharp change from pink to yellow this reservation of a portion is not necessary. With the methyl-orange and indigo-carmine indicator this preliminary operation is as follows: To 100 cc. H_2O, or the specified NaCl* solution, add 0.2 cc. methyl-orange and 0.2 cc. freshly prepared indigo-carmine and then carefully add a very dilute acid V.S. (HNO_3) until the green color changes without producing a violet tint; divide into two equal portions, placing these in beakers of the same internal diameter; to one add the solution to be titrated and reserve the other for comparison. MOI will be used as an abbreviation for this mixed indicator.

The preliminary operations for phenolphthalein (Ph.) and methyl-red (MR) have been described in this paper.

*Interpret percentage NaCl as grams per 100 cc.

Data for Standardization and Equivalent Weights.

Na_2CO_3 V.S. 11.3534 grams anhydrous Na_2CO_3 per liter
HNO_3 V.S. approximately deci-normal
NaOH V.S. " " freed from carbonate by the addition of a slight excess of $Ba(NO_3)_2$ and filtered.

10 cc. HNO_3 V.S. with MOI in water dilution required 8.4 cc. NaOH V.

10 cc. HNO_3 V.S. with Ph in presence of 10% NaCl required 8.4 cc. NaOH V.

10 cc. HNO_3 V.S. with MR in presence of $AgNO_3$ required 8.4 cc. NaOH V.

10 cc. Na_2CO_3 V.S. to which 30 cc. HNO_3 V.S. and then the MOI in water dilution were added required 8.05 cc. NaOH V.S., therefore

10 cc. Na_2CO_3 V.S. are equal to 17.15 cc. NaOH V.S. and
1 cc. NaOH V.S. is equivalent to 0.01499630 gram NaH_2PO_4, Ph.
0.00749815 " " MR.
0.004082786 " H_3PO_4 MR.
0.0061241785 " " Ph.
0.012248357 " " MOI

Mono-sodium Phosphate Analyses.

	"A"	"B_1"	"B_2"
Moisture at 100-110° C. over direct flame	21.50%	14.07%	10.49%
with fusion	33.25%	.....	.....
without fusion	33.35%	.....	.....
NaH_2PO_4			
weight in 100 cc.	2.003 gm.	2.004 gm.	2.0625 gm.
10 cc. with Ph. method	10.5 cc. NaOH	11.5 cc. NaOH	12.7 cc. NaOH
% NaH_2PO_4 indicated	78.61%	86.05%	92.34%
10 cc. with MR method	21. cc. NaOH	23. cc. NaOH	25.1 cc. NaOH
% NaH_2PO_4 indicated	78.61%	86.05%	91.25%

Samples "A" and "B_1" yielding the same percentage of NaH_2PO_4 by the two methods are free from H_3PO_4 and Na_2HPO_4; sample "B_2" yielding a higher percentage of NaH_2PO_4 by the Ph. method must contain free H_3PO_4; in the presence of Na_2HPO_4 the MR. results must exceed the Ph. results:

	With Ph.	*With MR.*
NaH_2PO_4 requires	1NaOH	2NaOH
H_3PO_4 requires	2NaOH	3NaOH
NaH_2PO_4 requires	1NaOH	2NaOH
Na_2HPO_4 requires	ONaOH	1NaOH

The H_3PO_4 content of "B_2" can be calculated in several ways:

(1) From the cc. NaOH V.S. used in the Ph. and MR. titrations:

with Ph: x = cc. for NaH_2PO_4; 2y = cc. for H_3PO_4
with MR: 2x = cc. for NaH_2PO_4; 3y = cc. for H_3PO_4.
x + 2y = 12.7 cc. and 2x + 3y = 25.1 cc. from which
Ph: x = 12.1 cc. and 2y = 0.6 cc.
MR: 2x + 24.2 cc. and 3y = 0.9 cc.

The same results are obtained

(4 x cc. Ph.) — (2 x cc. MR.) = cc. NaOH due to H_3PO_4, Ph;
Application: (4 x 12.7) — (2 x 25.1) = 0.6 cc. NaOH due to H_3PO_4 Ph. equal to 1.78%
cc. Ph. — cc. due to H_3PO_4 = cc. due to NaH_2PO_4, Ph;
Application: 12.7 cc. — 0.6 cc. due to H_3PO_4 = 12.1 cc. due to NaH_2PO_4, Ph., equal to 87.98%

(2) After calculating both tritation results to % NaH_2PO_4:

Ph: x = % NaH_2PO_4; 2y = % H_3PO_4.
MR: x = % NaH_2PO_4; 1½y = % H_3PO_4.
x + 2y = 92.34% and x + 1½y = 91.25%

therefore 2y = 4.36% NaH_2PO_4 due to H_3PO_4; as $1H_3PO_4$ equals $2NaH_2PO_4$ with Ph. in neutralizing power

$$\frac{H_3PO_4}{2NaH_2PO_4}$$ or 4.36 x 0.40848 = 1.78% H_3PO_4.

x = 92.34 — 4.36 = 87.98% NaH_2PO_4.

In a simpler manner:

Difference in % Ph. and MR. x 4 = % NaH_2PO_4 from the H_3PO_4 content;

Application: 92.34 — 91.25 = 1.09 x 4 = 4.36 % NaH_2PO_4 from the H_3PO_4 content:

then the calculation is continued as above.

(3) From cc. NaOH V.S. MOI: 10 cc. solution of "A" or "B_1" produced no change in 7.5% NaCl but did show a slight change in 10% NaCl* requiring 0.05 cc. NaOH V.S.; the addition to the MOI dilutions, 7.5% and 10% NaCl, of 0.05 cc. Na_2HPO_4

(2.2169 gm. in 100 cc.) produced a bright green color (alkaline reaction) while 0.05 cc. H_3PO_4 (.8386 gm. of 87% H_3PO_4 in 100 cc.) produced a violet color (acid reaction).

10 cc. "B_1" + 0.5 cc. of the same H_3PO_4 solution with MOI, 7.5% NaCl, required 0.3 cc. NaOH V.S. and with 10% NaCl required 0.35 cc. NaOH V.S. (10 cc. of the same H_3PO_4 in 10% NaCl required 5.95 cc. NaOH V.S. cc. so in presence of NaH_2PO_4 the presence of 7.5% NaCl gives closest results).

10 cc. "B_2" with MOI produced a distinct violet color and required varying quantities of NaOH V.S. depending upon the NaCl content:

thus in water dilution it required 0.1 cc. NaOH V.S.
in 5% NaCl " " " 0.25 cc. " "
" 7.5% NaCl " " " 0.30 cc. " "
" 10% NaCl " " " 0.40 cc. " "

From the experimental work here recorded the determination of H_3PO_4 in presence of Na_2HPO_4 is best made in presence of 7.5% NaCl, thus checking with the Ph. and MR. titrations.

0.3 cc. NaOH V.S. MOI indicate 1.78% H_3PO_4 in "B_2."

Summary of NaH_2PO_4 Results.

	$NaH_2PO_4H_2O$	"A"	"B_1"	"B_2"
H_2O at 100-110° C.	13.05%	21.50%	14.07%	10.49%
NaH_2PO_4	86.95%	78.61%	86.05%	87.98%
H_3PO_4	.....	.....	.....	1.78%
Na_2HPO_4	.....	.....	.....	.....
	100.00%	100.11%	100.12%	100.25%
Samples equal, $NaH_2PO_4H_2O$		90.41%	98.96%	101.18%

It would seem from these results that mono-sodium phosphate is made by evaporation of solutions until a dry product is obtained regardless of water content: in "B_2" the presence of H_3PO_4 did not readily yield a dry product so this was heated longer resulting in a product containing less than the theoretical quantity of water.

Assay of Phosphoric Acid.

The titration of mono-sodium phosphate in presence of NaCl, Ph., suggested the application of the method to the assay of phos-

phoric acid; titrations were made using a solution containing 0.8386 gm. H_3PO_4 in 100 cc. The results obtained by the three methods are shown in the tabulation, the cc. NaOH V.S. required for titration corresponding to three, two and one Hydrogen replaceable in the respective methods:

	NaOH V.S.	H_3PO_4
10 cc. + 30 cc. $AgNO_3$ V.S. MR.	17.9 cc.	87.15%
10 cc. + 10% NaCl* Ph.	11.9 cc.	86.89%
10 cc. + 10% NaCl* MOI	5.95 cc.	86.89%

*Interpret percentage of NaCl as grams per 100 cc.

STUDIES ON THE GREATER YAM (DIOSCOREA ALATA L.)*

By Heber W. Youngken, Ph. M., A. M., Ph. D.†

Several species of true yams have long been under cultivation in China, India, South America, the West Indies and the Pacific Islands on account of the valuable food qualities of their tubers or rhizomes. Prominent among those which have been extensively grown for the table in various of these countries are the Chinese Yam (*Dioscorea batatas* Decaisne), the Common Yams (*Dioscorea sativa* L. and *D. globosa* Roxb.), the Greater or Wing-Stalked Yam (*D. alata* L.) and the Indian Yam (*D. triloba* Lam.).

Upon learning of the successful attempt of the Bureau of Plant Industry in cultivating one of these, the Greater Yam, in the United States and of the similarity of its tubers to the white potato in food qualities, the writer became interested alike in its future possibilities as an extra potato-like food and in its structure and content.

Accordingly, he procured material of the small variety of this plant in the spring of 1923 from Mr. R. A. Young, Plant Introducer, connected with the Bureau of Plant Industry of the U. S. Department of Agriculture, and undertook a study of its history, character of the plant, physical characteristics, histology, and edible qualities of the tuber.

†Professor of Botany and Pharmacognosy, Philadelphia College of Pharmacy and Science.

*Presented at the 1923 Meeting of the Pennsylvania Pharmaceutical Association.

History of Dioscorea alata L.

The early records of this plant as found in Sanskrit medical works and of the *Dioscorea* genus, as found in the oldest work on medicine by the Chinese Emperor Schen-nung, point to its original home as Southern Asia.

Dr. U. C. Dutt[1] in his "Materia Medica of the Hindus" gives the Sanskrit name for this species as Dandalu.

Drury[2] states that it occurs in both Konkans and flowers during the rainy season.

According to Ainslie[3] and Watt[4] it is called Ubi or Uvi in Australia and Java.

A. DeCandolle[5] states that the Hindustani and Bengali call it "kam abi," also that it is the most commonly cultivated yam in the Pacific Isles.

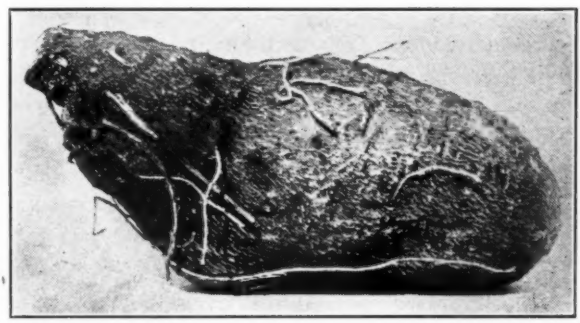


Fig. 1—Photograph of tuber of small variety of Dioscorea alata L, x 7/16.

Roxburgh[6] mentions it as the only species cultivated for food on the Coromandel Coast and that it flowers at the close of the rainy season.

Forster[7] and Rumphius,[8] authors of the 17th and 18th centuries, state that it is widely spread in Tahiti, in New Guinea and the Moluccas.

Sagot[9] states the free yam of Guiana is the *Dioscorea alata* which was introduced there from the Malay Archipelago and Polynesia.

Watt[4] in his "Dictionary of Economic Products" of India calls the plant Yam, Wing-Stalked Yam and Barbadoes Yam and states that it is much cultivated in various parts of India and that its tubers are extensively eaten by the natives.

At the present time the Bureau of Plant Industry at Washington has two varieties of the *D. alata* under observation, *viz.*, the large and the small yam. The small yam is listed under S. P. I. No. 46801 and is the particular variety whose physical characteristics and histology will receive treatment in this paper.

It was obtained by Dr. David Fairchild in the spring of 1918 from Prof. C. T. Simpson, of Littleriver, Florida, and is said to grow well in light and in rich sandy soils as well as in muck.

Description of the Plant.

Dioscorea alata L., commonly known as the Greater Yam, Wing-Stalked Yam or Yam is a perennial, herbaceous, dioecious vine indigenous to Southern Asia and cultivated in many tropical and sub-tropical countries. Its underground portion consists of a system of 2 to 5 tubers bearing numerous fibrous roots. Its aerial portion is characterized by long, 4-angled or winged climbing stems (or procumbent when without support) bearing opposite, cordate-ovate, glabrous, 7-9 nerved, netted leaves, also by the appearance of a number of aerial tubers by which the plant is commonly propagated. Two kinds of plants occur, staminate and pistillate. The staminate plants bear compound spikes of small, greenish-yellow, regular flowers, each with 6 stamens having subglobose anthers. The pistillate plants bear simple spikes of small greenish flowers, each possessing a 6-cleft, calyx-like perianth and a pistil composed of a 3-celled ovary and 3 styles. The fruit is a 3-winged leathery, loculicidally dehiscent capsule.

Description of the Tuber.

The tuber examined by the writer was of irregular-oblong shape, 16 cm. long and varying in different parts from 4 to 7 cm. in width; of brown color externally and marked by the presence of a rough, cracked, suberous skin, showing numerous, filiform, fibrous rootlets and root scars and two conical buds, near the summit. Internally it exhibited a whitish, mucilaginous surface, and showed differentiation into a narrow cortical and extremely broad central cylinder zone separated from one another by a slightly wavy narrow ring of sclerenchyma elements. Its taste in the raw condition was starchy and mucilagious, somewhat resembling the potato.

L. H. Bailey[19] states these tubers sometimes attain the length of 6 to 8 feet and weigh up to 100 pounds. These must have represented the tubers of the large variety.

Histology of the Tuber.

Under the microscope the following structures are to be noted in passing from periphery toward the center.

1. Cork of several layers of suberous cells the outer ones in the process of exfoliation. These cells are polygonal as observed in surface sections and tangentially-elongated in transversely cut ones.

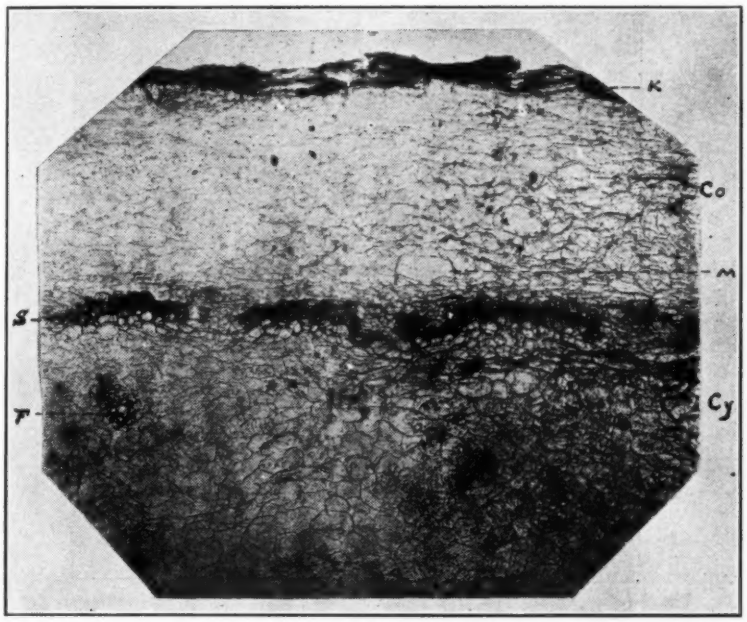


Fig. 2—Transverse section of representative portion of tuber of the small variety of Dioscorea alata L, cleared with chloral, showing cork (K); cortex (Co), containing mucilage sacs, one of which is shown at (M) and starch parenchyma; wavy, interrupted zone of stone cells (S); and starch parenchyma of central cylinder (Cy), the latter containing scattered collateral, fibrovascular bundles, one of which is shown at (F). x 70. Photomicrograph.

2. Cork cambium, a zone of meristematic cells.

3. Cortex, a comparatively narrow zone of 20 or more layers of tangentially-elongated starch-parenchyma cells, scattered among which are larger mucilage and raphide containing cells. Some of the raphides measured were up to 190 microns in length.

4. No distinct endodermis occurs.

5. A narrow, interrupted, slightly wavy zone of sclerenchyma containing many disjoined arcs of stone cells. These stone cells show various degrees of lignification of their walls as well as numerous prominent pore canals. Moreover, their walls are unevenly thickened.

found a monoclinic prism of calcium oxalate (see Fig. 3). Crystals of calcium oxalate have also been found in the stone cells of *Juniperus communis* fruits and in the roots of *Jateorrhiza palmata.* In some instances more than one monoclinic prism has been observed in a single stone cell.

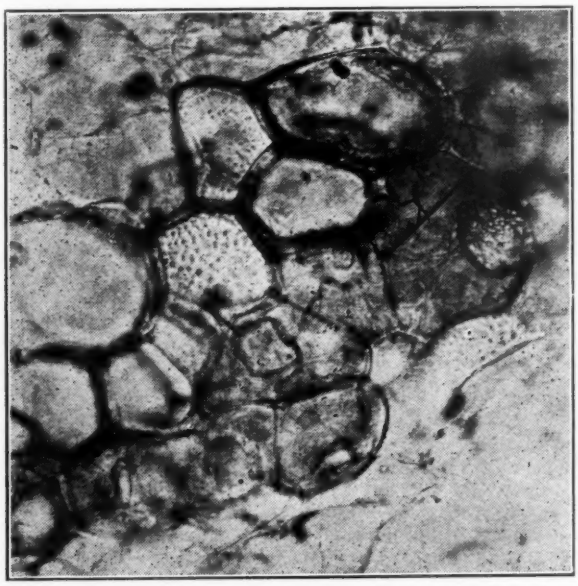


Fig. 3—Photomicrograph of a group of stone cells from a sclerenchyma arc of the tuber of Dioscorea alata L. Some of the stone cells show a crystal of calcium oxalate in their lumina, x 600.

Within the central canal or lumen of most of them is to be

Further, it is to be noted that some of the ordinary thin-walled cells which connect adjacent sclerenchyma areas show various stages of transition as to their walls from the cellulose to the lignocellulose types.

While the writer as yet has been unable to study the minute anatomical details of more than one of the tubers, the morphologic

evidences seen in the transition areas seems to prophesy the possibility of a completely closed sclerenchyma ring in the tubers of younger growth. A similar condition is to be observed in the climbing stems of several species of *Aristolochia.*

6. A broad Central Cylinder, occupying the center of the tuber and composed of a matrix of starch parenchyma interspersed among the cells of which are numerous mucilage sacs, some containing raphides of calcium oxalate. Numerous collateral fibrovascular bundles course through this region. As in other monocotyledonous stems, these may be truly said to be scattered, although there is a

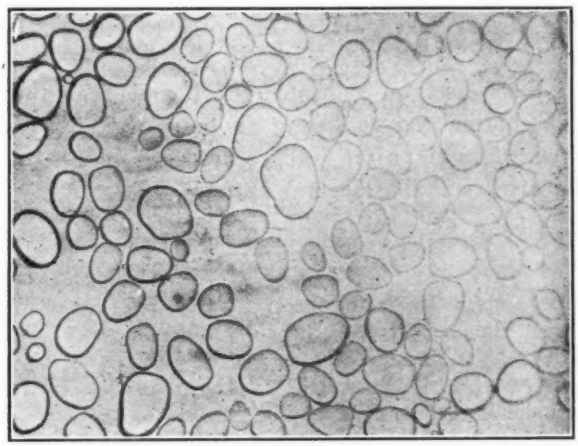


Fig. 4—Starch grains separated from the tuber of Dioscorea alata L, x 300. Photomicrograph.

tendency for the outer bundles to be arranged in somewhat circular fashion as in the stems of dicotyledons. The xylem region of these bundles is marked by the presence of reticulate and scalariform tracheæ and tracheids. Starch completely filled the parenchyma cells of the cortical and central cylinder regions. The grains are simple, of ellipsoidal, irregularly rounded, ovate or elliptic-truncate shape, up to 41 microns in length, the larger and more typical ones showing an eccentric hilum at the narrower end and concentric as well as eccentric lamellæ and striations. The latter are not usually very distinct until sprouting of the tuber takes place. Polarization crosses are distinct and a marked play of colors is evident with the selenite plate.

The Greater Yam as an Article of Diet.

Because of its abundant carbohydrate content and delicacy of flavor, this yam will undoubtedly be welcomed by Americans as an addition to their variety of potato-like foods. When cooked it possesses a white, mealy flesh which is dry and rather coarse grained. Less time is required for cooking than for potatoes of equal size.

As in the preparation of white potatoes for the table the Greater Yam may be mashed, baked, boiled, fried, French fried, diced and served with cream sauce or as a salad. In preparing mashed Yam care should be observed in having a low fire, to prevent the peeled tubers from adhering to the bottom of the cooking utensils. After draining off the water they should be mashed in the vessel on a heated stove and beaten thoroughly, adding milk, butter and seasoning as desired. This dish is best when served promptly after its preparation, since it usually becomes firm after standing several minutes.

BIBLIOGRAPHY.

1. Dutt: "Materia Medica of the Hindus," p. 296.
2. Drury: "Handbook Ind. Fl.," Vol. 3, p. 274.
3. Ainslee: "Mat. Ind.," Vol. 1, p. 329.
4. Watt: "Dict. Econ. Prod. Ind.," Vol. 3, p. 126.
5. DeCandolle: "Origin Cult. Pl.," p. 79.
6. Roxburgh: "Flora Ind.," Ed. C. B. C., p. 727.
7. Forster: "Plant. Esculent.," p. 56.
8. Rumphius: "Amboin," Vol. 5, pl. 120, 121.
9. Sagot: "Bull. de la Soc. Bot. de France," 1871, p. 305.
10. Bailey: "Stand. Cycl. Horticult.," 3d Ed., Vol. 2, p. 1013.

THE DETECTION OF OLIVE OIL IN SOME REFINED VEGETABLE OILS.

W. H. Dickhart, New York Produce Exchange.

While the writer was analyzing cottonseed fatty acids for resin acids the method required the fatty acids to be treated with a solution containing one volume of concentrated sulphuric acid and four volumes of absolute alcohol. After applying 5 cc. of this solution to 5 cc. of pure olive oil in a test tube and shaking a

minute or two to form an emulsion, there was then added ten drops of a 2 per cent. alcoholic solution of Furfurol, and after shaking the tube was placed into the hot water bath for a short time, the tube being shaken every few seconds. The lower solution became a dark cherry red and after standing at room temperature for a few minutes much darker. Refined cottonseed oil however failed to give this color even when heated for a long time.

Corn, castor, chinawood, hempseed, kapok, peanut, perilla, palm, palm kernel, lumbang, mustard, rapeseed, teaseed, linseed, soya bean, cocoanut and tobaccoseed oil were tested in the same way.

A few of the oils, such as palm kernel, peanut, cocoanut, teaseed and castor gave a slight red coloration, but on the addition of 10 cc. of water to the mixture after treatment the color disappeared, leaving a milky solution, while olive oil retained the red color when treated in the same manner.

Sesame oil gave a pink color in the cold like that of the Villavecchia test, but a dark lavender to almost black precipitate in the hot. Strange to say the pink color which first formed in the cold disappeared on the addition of water, showing the test to be different from that of the Villavecchia test for sesame and which acted more like some Spanish olive oils.

Mustard oil gave a greenish blue, but like the other oils a milky solution with water.

From the above experiments the following method was decided upon: Solution "A." Pour slowly one part of concentrated sulphuric acid into four parts of absolute alcohol, placing the graduate in cold water if necessary to reduce the temperature. Solution "B." A 2 per cent. alcoholic solution of Furfurol.

Place 5 cc. of sample in a test tube, add 5 cc. of solution "A" and shake to form an emulsion, then drop into this emulsion 10 drops of solution "B"; again shake. A pink color at this stage indicates sesame oil. Place the tube into the hot water bath, which must read 94 to 95° C. and heat for one and one-half minutes, shaking every few seconds. Remove from the bath and add 10 cc. of cold water. Again shake and allow it to stand for 5 or 10 minutes. A red color to the solution indicates olive oil. All the other oils tested above gave a milky solution when treated in the same way.

Samples of refined cottonseed, soya bean, peanut, teaseed, corn

oil, etc., containing 2, 3, to 5 per cent. olive oil were tested and the color compared with a blank that was made at the same time in the same way. The red color was so pronounced that there could be no question of the contamination.

One important feature of the test is that it will differentiate between teaseed oil and olive oil.

The olive oils tested were pure edible olive oil, commercial olive oil and refined oil made from olive oil foots.

Where sesame oil is present in an oil, owing to the dark precipitate formed, olive oil cannot be detected by the above method.

If oil of rosemary is present in excess in an olive oil 15 cc. of water should be used instead of the required 10 cc. called for in the method and the color of the solution is a darker red, more of a chocolate color. The oil is also much darker.

IN MEMORIAM.

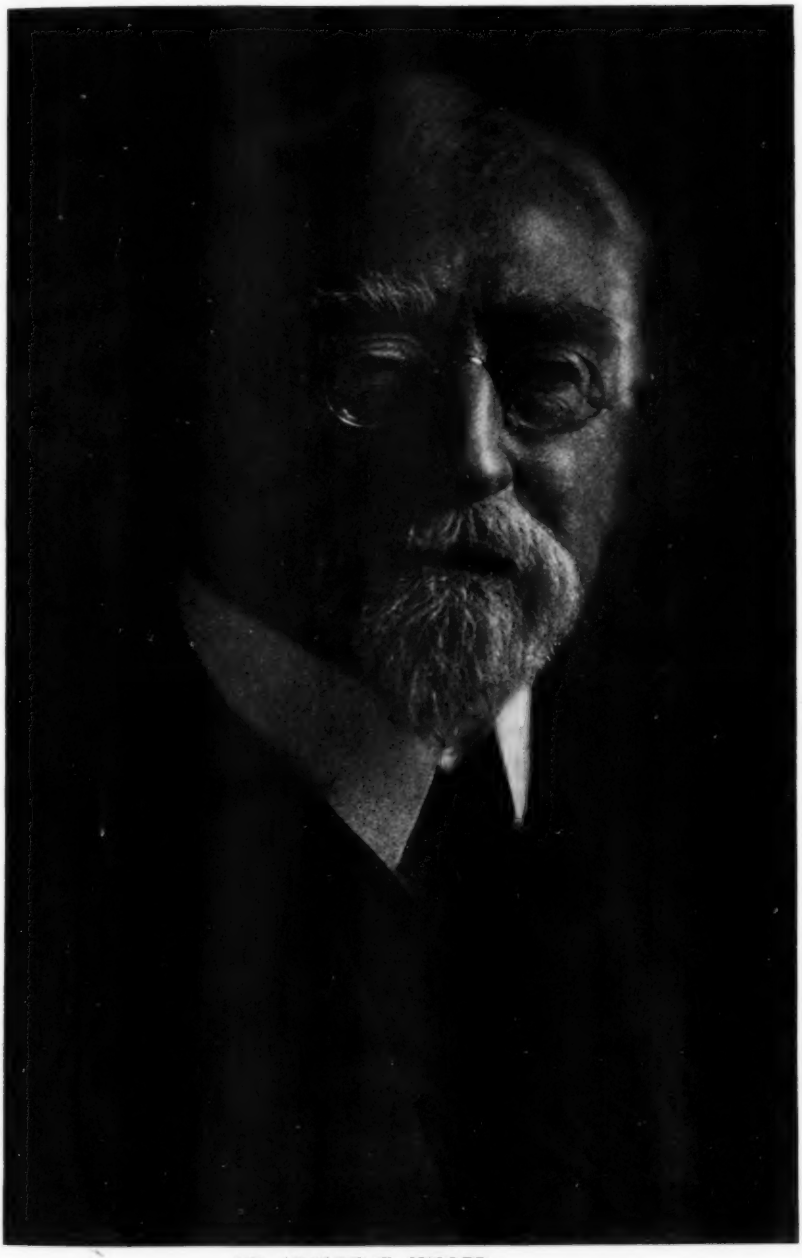
DR. ADOLPH W. MILLER.

By George M. Beringer, A. M., Ph. M.

Adolph William Miller was born October 8, 1841, at Berge, Hanover, in a building then occupied by his father, William H. Miller, as a branch of the pharmacy of his maternal grandfather, Franz von Lengerken, situated at Ankum, some three miles distant. In the fall of 1848, when Adolph was about seven years of age, his parents emigrated to America. Crossing the ocean in a sailing vessel they landed at New Orleans and then proceeded up the Mississippi River by steamboat to St. Louis.

His father purchased a property at Belleville, Ill., about fourteen miles east of St. Louis, and opened there a drug store. Here Adolph attended the public schools for five years and also received private instructions in the languages. Doubtless it was this early instruction that laid the foundation for the linguistic attainments for which in later life he was noted.

At the age of twelve years Adolph engaged with Edward T. Robinson, whose drug store was located at the southwest corner of Fourth and Market Streets, St. Louis. Mr. Robinson had served his apprenticeship with the then prominent Philadelphia druggists,



DR. ADOLPH W. MILLER.

Bullock and Crenshaw, and had been but recently graduated from the Philadelphia College of Pharmacy in the class of 1853.

Here Adolph commenced his business career at the bottom of the ladder. On several occasions the writer has heard him describe the errand work and menial services that fell to the lot of the junior drug apprentice in those days. His employment in this store continued for four years. In this interim, the business changed hands, Mr. Robinson being succeeded by Robert Parham and Samuel W. Kendel. Mr. Kendel was likewise a graduate of the Philadelphia College of Pharmacy of the class of 1852, and, while in Philadelphia, had been in the employ of Henry C. Blair. The impressions made upon him by these two graduates of the old college who were continually recounting the praise of their Alma Mater had a determining influence upon his future career.

In the meantime, his father had sold his property at Belleville and opened up a store at St. Paul, Minn., then only a frontier post, and in 1857 Adolph joined his father in this business. While in St. Paul he continued his academic education at the college of St. Paul, taking up instructions in the languages and mathematics.

The encomiums of the Philadelphia College of Pharmacy extolled by his former employers, predetermined Adolph to obtain a collegiate education in pharmacy at this institution, and so in the spring of 1860 he came to Philadelphia. He obtained employment in the drug store of Ferdinand Rollman, at Twelfth and Spring Garden Streets. Subsequently, he engaged with Henry O. D. Banks, at Fourth and Callowhill Streets. In 1862, he completed the pharmacy course and was graduated from the Philadelphia College of Pharmacy. Immediately thereafter he became a partner in the business of Henry O. D. Banks & Co. Upon the retirement of Mr. Banks three years later the new firm of Aschenbach and Miller was founded and this firm removed to the northwest corner of Third and Callowhill Streets, where it has since continued in a prosperous and extensive wholesale drug business. For the greater portion of this long period Doctor Miller was the active spirit that guided this growing business and until his final illness kept in daily touch with its business activities.

While pharmacy always remained the vocation to which his life was devoted he appreciated the educational value and the benefit to be derived from study in other fields. In order to obtain a broader knowledge of medicines and their application to diseases he took

up the study of medicine. He matriculated at the Jefferson Medical College in 1869, and attended there one full course of lectures. At this period the instruction in the medical colleges usually consisted of two courses of lectures, which were largely duplications. In order to obtain the best views and fullest information then available he took his second full course of lectures in the Medical Department of the University of Pennsylvania, from which he was graduated in 1871. The following year he attended a post graduate course, or, as it was then called, the "auxiliary course in medicine" at the University and upon concluding this received the degree of Doctor of Philosophy.

It is interesting to note that this auxiliary course in the University of Pennsylvania had been founded and endowed by Dr. George B. Wood, who had devoted himself to the advancement of medicine and pharmacy and who during his life's span was preeminent for his contributions to the literature and teaching of these professions.

That Doctor Miller's practical experience as an apothecary, his education in both medicine and pharmacy, his broad scientific knowledge, his linguistic and conversational attainments and his genial personality constituted an unusual combination of qualifications that well fitted him for teaching was soon recognized by his Alma Mater and in 1878 he was appointed Demonstrator of Pharmacy in the University of Pennsylvania. It was his good fortune here to be associated with Dr. Horatio C. Wood, that master mind in medicine and authority in therapeutics. In 1890 Dr. Miller was made lecturer in Materia Medica and he retained this position until 1909, when he resigned.

Dr. Miller possessed an unusual aptitude for the mastering of languages and throughout his life he maintained a keen interest in philology. In recognition of his interest and attainments in the study of the languages the honorary title of D. O. was conferred upon him by the Mount Vernon Institute of Elocution and Languages of Philadelphia. These studies were a source of much satisfaction to him and gave him an insight into many interesting topics and often enabled him to interrogate difficult subjects. Etymology, a much neglected study in these days, was one of his principal accomplishments and he was always delighted to explain the derivation and meaning of botanical terms and many obscure scientific words. In a large measure this also explains his knowl-

edge of drug synonyms in which he was unusually proficient and as a local authority therein he was frequently appealed to by fellow druggists. It also contributed to his recognized choice of words and the culture and fluency of his expression.

He was likewise a student of archæology and of mythology and these frequently became topics of his conversation and his discussions evidenced that he was well versed in these studies.

He always took a vital interest in the local botanical organizations and with ability and energy accepted his share of the responsibility of their management. He was a member of the Academy of Natural Sciences, the Botanical Society of Pennsylvania in which he served as president; the Philadelphia Botanical Club, the Lotus Club of which he was president. He was likewise treasurer of the John Bartram Association and was one of the principal workers in this organization, whose object is to perpetuate the memory and work of John Bartram and to preserve the Bartram home and garden, especially the trees which he had planted, and to restore this to its original beauty. Largely through the efforts of another eminent Philadelphia botanist, Thomas Meeham, Bartram's Garden was acquired in 1887 as one of Philadelphia's public parks.

Dr. Miller also held membership in many other societies of a technical or educational nature, such as the Franklin Institute, the Geographical Society, the Natural History Society, the City Historical Society, the Germantown Horticulture Society.

He always maintained an active interest in the pharmaceutical societies. He became a member of the American Pharmaceutical Association in 1868 and of the Pennsylvania Pharmaceutical Association in 1887. He served as president of the Alumni Association of the Philadelphia College of Pharmacy (1875-1876). He was elected corresponding secretary of the Philadelphia College of Pharmacy in 1886, which position he held to the time of his decease. He was a member of the Philadelphia Drug Exchange, of which trade body he served as a director for many years and as president in 1891, 1908, 1909.

Doctor Miller was essentially a business man. His various commercial interests claimed his attention continually, and, until a few days of his final illness, he spent a portion of each day at his desk actively engaged in the management of a steadily growing jobbing drug and manufacturing pharmaceutical business. He was

recognized as a cautious, conservative, representative drug merchant whose judgment and application had brought to him material success. He was a noteworthy example of a type of business man now only too rare, who, while devoted to his vocation, was not so slavishly engrossed therein that he coud not give some of his time and interest to allied scientific and professional organizations.

Every person who has achieved anything worth while in life, or who has risen to a position above the average, owes his success and prominence to traits developed by overcoming the trials and tribulations that were the annoying problems of his earlier career, and generally these occur during the formative period of the individual's life. Those who were so favored as to hear the reminiscences of his early career in the drug business and the obstacles in his path know that in the fullest sense Adolph W. Miller was a self-made man who by reason of this experience and training had inculcated the traits of perseverance, determination and application by which he had carved out his own fortune.

A dominant characteristic was his liberality and tolerance. While holding firmly to his own views and opinions he always respected the right of others to their opinions and tolerated the greatest freedom in their presentation.

In the decease of Dr. Adolph W. Miller, on Friday, July 6, 1923, the City of Philadelphia lost one of its most useful and honored citizens who possessed a unique personality and filled a position in its circles that cannot again be filled.

During his life he had taken his part in many activities of a public or semi-public character and now in full fruition approached the inevitable end of all life. Of no one can it more fittingly be said,

"Life's work well done,
Life's race well run;
Life's work well done,
Then comes rest."

A large gathering of friends attended the funeral services on July 9 to pay their final tributes of respect and esteem. Among those who made eulogistic addresses were: Dr. Henry Leffmann, Prof. John M. Macfarlane, Charles E. Hires, Prof. Charles H. LaWall and Rear Admiral William C. Braisted.

ABSTRACTED AND REPRINTED ARTICLES

A WORTHY MEMORIAL.*

Not long since, the centenary of the Philadelphia College of Pharmacy, founded in 1821, and incorporated by charter in 1822, was celebrated in the city by a series of impressive functions in which many of the leaders in American pharmacy took part. There has now reached us a sumptuous volume of 730 pages, entitled "The First Century of the Philadelphia College of Pharmacy, 1821-1921," edited by Mr. Joseph W. England, one of the versatile men of science in whom the United States is so rich. A Philadelphia correspondent happily remarks that the history is virtually a cross-section of American pharmacy; it would be almost equally true to say that to all intents and purposes it is an encyclopædia of pharmacy in the States. Not only are there annotated lists of the graduates of the College and of the Department of Pharmacy and Chemistry of the Medico-Chirurgical College (which the College absorbed in 1916), but practically every American pharmacist of note appears to find a place in the index, while in the text each of the more important biographies comprise a portrait. Parrish and Remington, Maisch and Squibb, Warner and Fairchild—these and others whose names are household words are enshrined in a record that, as time goes on, will prove to be indispensable. Wisely, we think, the first chapter of the book is devoted to establishing the atmosphere of Philadelphia in the year 1821; and in order to do this it has been necessary to go a little further back. The accounts given of the drug-trade, wholesale and retail, prior to the establishment of the College are of singular interest. Take, for instance, the following extract from an address given by Mr. Samuel F. Troth in 1864:

> Epsom salts were very little used when I was an apprentice; we used to purchase from 20 to 40 pounds of Glauber at a time, at 2¼ cents per pound, while we would only buy a single keg of Epsom, holding about 25 pounds, at 15 cents. The first really nice Epsom salts I recollect having in our store was the

*From the *Chemist and Druggist*, England.

> year the College was organized; John Farr, the noted chemist, was going to pay a visit to his friends in London, and offered to make some purchases for us, and one of the articles in that first importation of our house was two casks, 1190 pounds of beautiful Epsom salts, at a cost here of 7 cents per pound, which was so much in demand by the retailers that we increased our orders, until the Baltimore manufacturers put a stop to our importations of the article. . . . Forty years ago all the calcined magnesia we sold was burned in Abram Miller's pottery, opposite this building, where the public school now stands; we used to take a case of English carb. magnesia, pick out some of the nicest and hardest lumps, and pack the balance in earthen crocks procured from the pottery, and send them around to be put in the kiln when Miller burned his ware.

The first firm to manufacture chemicals in the States, it is believed was that of Christopher and Charles Marshall, who, as early as 1786, made muriate of ammonia and Glauber's salt. The eldest daughter of Charles "was probably the first American woman pharmacist, and continued to manage the business until 1825." The shop of the Marshalls and that of John Speakman, an apothecary, are instanced as of a professional type, which was exceptional then.

> In many cases, in the retail as well as the wholesale stores, the sale of medicines in the early part of the nineteenth, as in the eighteenth century, was combined with trade in paints, varnishes, oils, window glass, dyestuffs and garden seeds. These heavy articles of merchandise were distributed by the same hands from which a customer received rhubarb, magnesia and calomel.

The opening chapter ends with a list, extending to four pages, of noteworthy events of the year 1821. We have not space to make a more extended reference to it, but we signal it out as symptomatic of the thoroughness with which the editor of the book and his helpers have accomplished their task—a task extending over several years, and doubtlessly involving, here and there, heroic condensation of the abundant material. For a connected history of the College we must perforce refer our readers to the volume itself; it will suffice to mention here, by way of rough outline, that the institution, founded (as we have said) in 1821, moved into a home of its own for the first time in 1832, erected a new building in 1868, and rebuilt on a larger scale in 1892-93. The College soon made its

influence felt. So early as 1824 there was published "Formulæ for the Preparation of Eight Patent Medicines, adopted by the Philadelphia College of Pharmacy," the eight being Hooper's Female Pills, Anderson's Scots Pills, Bateman's Pectoral Drops, Godfrey's Cordial, Dalby's Carminative, Turlington's Balsam of Life, Steer's Opodeldoc, and British Oil. A committee had been nominated for this purpose two years previously; and in presenting its report it summed up the pros and cons of the new departure in the judicial remark that "in stripping these medicines of their extravagant pretensions and false assertions, the committee are aware that they incur some risk of decreasing their sale. As they now stand, however, . . . owing to the very gross falsifications that have been vended under their name, the confidence of the public in them, and their consequent sale, have, no doubt, lessened." There appears to have been no hesitation on the part of the College in publishing the formulas suggested by the committee, of whose work our author writes:

> It was an important service. For instance, ivory black, which has been used in many cases for making Hooper's Female Pills, was rejected as "a clumsy and barbarous ingredient." In Bateman's Drops, the committee found 7½ grains of opium to the pint in one formula in use by American apothecaries and 106 grains to the pint in another formula. The camphor content varied still more. Castor appeared in some recipes in place of catechu, "which it in no way resembles."

From the first, in such ways as these, the College became intensified with American pharmacy in the manifold problems of its evolution. In the convention, for example, held on October 15, 1851, from which convention arose the American Pharmaceutical Association, the delegates of the Philadelphia College played a leading part. We are almost tempted to regret that the numerous references to the United States Pharmacopœia and its forerunners and to the U. S. Dispensatory have not been assembled and expanded into a chapter of their own, so important is the subject from an historical standpoint. As it is, the whole of the Latin Pharmacopœia of thirty-two pages, published in Philadelphia in 1778, is reproduced in facsimile, a proceeding followed also in the case of the title page of the first U. S. Pharmacopœia (1820), and of various documents. The illustrations number 300 in all, and they are so admirably printed that the caveat in the preface as to those

made from old paintings and faded photographs seems unnecessary. In only one case have we noticed a portrait of a living member of the trade that "dates," and, of course, it may reasonably be urged that in a work of reference of this kind each celebrity can only be represented as he was at one period of his career. The *format* of the book is a delight to the eye, and the proof-reading has obviously been done with scrupulous care. English-speaking readers in any part of the world who desire a compendium of such matters as laws affecting pharmacy in the United States or reciprocity between the separate States in pharmaceutical qualification will find the work of value; but it is much more than a compendium. The narrative moves with an easy swing, rising at times to forceful eloquence, that indicates a proper pride in the distinguished institution forming its subject-matter and a vigilant regard for pharmacy in its widest aspects. Since receiving the volume we notice that a policy of expansion has been decided upon, and that a building site has been purchased by the officers, the Board of Trustees and the Faculty. Alumni in all parts of the world are being asked to raise an adequate sum for new buildings and endowments; and we have no doubt that the response will be commensurate with the world-wide prestige of the College.

THE PROGRESS OF MEDICINE.*

A Plea for the Concerted Efforts of the Clinician and the Laboratory Worker.†

Arnold B. Luckhardt Ph. D., M. D.
Chicago.

Medical men the world over can be divided roughly into two groups: the majority have committed themselves to the care and treatment of the sick; the minority are engaged at research in some one of the sciences fundamental to practical medicine, devoting, very often of necessity, part of the time in teaching the principles of their science to our future practitioners. Although both groups are intensely interested in the progress of medicine, each group,

*Reprinted from the *Journal of the American Medical Association.*

†Chairman's address, read before the Section on Pathology and Physiology at the Seventy-fourth Annual Session of the American Medical Association, San Francisco, June, 1923.

curiously enough, views the work of the other either with a silent disregard or more often with disdain or openly expressed contempt. Forgetting that the best men in both groups are doing their utmost to contribute their share to the science of medicine, the clinician often ridicules the results of scientific investigation or the problem itself as devoid of practical significance; the laboratory worker in turn shows by attitude and speech his conviction that he alone is capable of making accurate observations and sound deductions.

Being allowed to mingle with both groups because of a somewhat dual nature, I have heard each group on occasion attempt to criticize the alleged shortcomings of the other without reflecting that at each occasion I was not only the listener but in part also the subject of the verbal punishment. Self-respect, if nothing more, forced me to conclude that both groups were wrong in part, and by a little reflection it was possible for me to gather evidence to support this conclusion. What there is of a science of medicine is the result of the efforts of both groups. The efforts have rarely been concerted. Had they been so, progress in medicine would have been more rapid.

Value of Both Groups to Medicine.

1. *Our Debt to the Clinician.*—Many of our present-day academic men need to be reminded that most of our modern surgical technic, except asepsis and antisepsis in its modern sense, was perfected to a great measure without aid from the laboratory; that both the technical procedures and the instrumentarium were developed on the field of battle or in the clinic. No one will deny the value of percussion and auscultation in the diagnosis, differential diagnosis, prognosis and treatment of many diseases. Both methods were discovered and perfected by clinicians and used by them in the fields of internal medicine, surgery and obstetrics alike, to the great advantage of suffering humanity. The accurate and detailed observations of morbid processes and deductions based thereon, as recorded in the works of Hippocrates, Sydenham, Hunter and a host of others, will remain forever scientific classics in medicine. Who will deny that the discovery of anesthetics by Long, Morton, Jackson, Wells and Simpson did not lead rapidly to a better surgery; and that the preventive vaccination of Jenner and the clinical researches of Holmes and Semmelweis were fundamental for the science of immunology, bacteriology and preventive medicine? These

few historical facts are commonly disregarded or forgotten by many of our scientific colleagues who may know them. During the major portion of their lives they think of the average physician and surgeon as an unscientific meddler with disease, an inaccurate observer, a prescriber of many and useless drugs, who in spite of bungling accumulates more or less dishonestly somewhat of a fortune. It is interesting to observe, however, that at times of sickness our scientific men seek both sympathy and help from such of the profession as are most skilled in surgery and who have spent their lives in the practice of medicine along the lines marked out by a Sydenham, a Laënnec, and Auenbrugger or an Osler.

2. *Our Debt to the Laboratory Worker in the Preclinical Sciences.*—The modern clinician, on the other hand, very often criticizes unjustly the entire lot of laboratory workers engaged in research in the sciences fundamental to medicine. The general nature of the attack, particularly on the anatomists, physiologists, biochemists and pharmacologists, is to the effect that their problems are of academic interest only, and often hardly that. They apparently forget that in the past many solutions of so-called academic problems have eventually contributed greatly to the diagnosis, prognosis and successful treatment of disease. To the practical men of his day, Harvey was discredited not only for the discovery of the circulation, but also for the type of animals he chose to solve the problem. Yet the establishment of his thesis revolutionized the practice of medicine. I have no doubt that the account by Leeuwenhoek, of the erythrocytes present in the circulating blood and his description of the capillary circulation and its significance, created no particular stir in medical circles. Certain it is that the discovery by the Rev. Stephen Hales of the exact value of the pressure of the blood in the blood vessels was not deemed of any more medical importance than his measurement of the pressure, exerted against a manometer, of the flow of sap in a vine. Now every clinician uses almost daily a hemocytometer and a sphygmomanometer. But does he remember that these useful instruments of precision are the results of investigations which in their infancy were of scientific interest only?

Who of the practitioners of the day were interested in the nature of alcoholic and acetic fermentation? And yet, as the direct result of this study, Pasteur, the chemist, created the science of

bacteriology, so important in the industries and even of greater importance to us in medicine. If the electrocardiograph is of value to medicine, it should be remembered that it had its origin in the physiologic laboratory in an academic study of action currents by a capillary electrometer or string galvanometer. Who will deny that pharmacologists have contributed much to our knowledge of the action of, indications for, therapeutic use and standardization of drugs, as well as to the synthesis of new ones? Are not valuable studies of the blood and urine made possible now because of the accurate methods devised and perfected by biochemists and immunologists working at the start, and to a great extent even now, in the laboratory and not at the bedside? And yet in their inception the problems for which the methods were devised were of little practical moment Let no one, therefore, use the term "academic" in the usual derogatory sense, for the solution of an academic problem today may be of immense practical importance tomorrow.

The Causes of This Reciprocal Attitude.

The nature of the daily work of the average physician obviously directs him to efforts in practical measures for the relief and cure of the sick. As a result he has neither interest in or time for the prosecution of problems whose solution promises no immediate practical application, nor has he often vision enough to appreciate the fact that any knowledge regarding the nature and mode of activity of living protoplasm, however obtained, must eventually be of practical value in the control, cure and prevention of disease; for who will deny that we will cope most successfully with disease when our knowledge of the mechanism of life is more complete? Complete knowledge of function must precede an accurate diagnosis and a scientific therapeusis. Knowledge gained empirically is of the utmost value. But in the repair of a watch, automobile or any fine piece of machinery, we get the quickest and most satisfactory results from him who is thoroughly familiar with the "anatomy," "physiology" and "pathology" of the mechanism. Empiric methods do not conduce to rapidity of progress in any field of endeavor except as these methods in turn stimulate to an investigation of the why and the wherefore of the successful result.

The essential cause, however, of this mutual misunderstanding, so prevalent among even the best representatives of both groups, is

profound ignorance of each other's work. As a rule, the laboratory man has never had an occasion to observe with what care and scientific acumen the good clinician gathers and weighs his data before instituting a rational and effective therapy. The clinician, on the other hand, rarely is in a position to observe and appreciate the resource, patience and pertinacity required of the laboratory man in order to solve a research problem the results of which are subsequently so readily susceptible of practical application. And yet the history of our profession indicates that both types are important in the steady progress of medicine as a science.

The Ideal.

There are some clinicians who gage their success in medicine by the state of luxury which a large and lucrative practice affords. satisfied with this criterion, they view with an air of superiority those who are struggling with fundamental biologic problems, forgetting that their medical and financial success is due essentially to the type of man whom they belittle. In the academic field, on the other hand, there are a goodly number whose activities are too often entirely foreign to medicine or the special science which they are presumably cultivating. They are enjoying thoroughly their academic freedom at golf, tennis, billiards or chess. Neither the wealth of the one nor the knowledge of the other will be of value in the progress of medicine.

For progress in medicine we must have the concerted efforts of both the clinician and the laboratory worker. The former must acquire a more thorough knowledge of the fundamentals than most possess at present; the latter should certainly have a medical background or a real interest in clinical medicine as a basis for his research. Overspecialization to a point at which men are ignorant of and have no interest in even closely related preclinical subjects is, generally speaking, disastrous alike to the teaching of medical students and to research in their specialty.

The great obstacle in attaining the latter ideal consists in the practical difficulty of inducing men having some or considerable training in both the clinic and the laboratory to enter or re-enter the laboratory at a great financial sacrifice, particularly in this country, where standing in a community is so largely determined by the wealth of the individual.

There is ample evidence, on the other hand, that many of the

younger clinicians, on the basis of a more fundamental training, are attacking clinical problems with modern methods developed essentially in the laboratories of the fundamental sciences. But at present such researchers are often considered by their colleagues as "queer." Their efforts to advance medical science are considered by the "leaders" of the profession as of no merit compared with the successful practice of medicine.

Some knowledge of and interest in clinical medicine, however obtained, will enable the laboratory worker to follow infinitely more intelligently than at present any presentation of a clinical paper. Having this knowledge, he will need no special invitation to attend the meetings of the various medical societies. Because of detailed knowledge in several of the fundamental sciences, he will not only be able on occasion to add a helpful discussion, but in turn may find for himself problems whose solution will be of immediate and great practical value to the clinician. A high degree of specialization as it exists today is of the utmost importance for progress. But a monthly review of the research output in any of the preclinical subjects calls to mind a statement of Verworn in the first chapter of his "General Physiology":

> But there is a difference whether one engages in researches of a special nature in order to help solve a problem to meet a practical or theoretical need of life, or whether one engages in special investigations, suggested fortuitously or because of any other superficial circumstance in order to determine whether anything would come out of the research and what it might be. The first is true research, the second entirely a pastime.

The problems in clinical medicine awaiting a practical solution are numerous. In these problems the highly specialized laboratory man is not interested chiefly because he has no knowledge of them. With a general medical background, he would give these problems the attention now devoted to problems of a highly technical nature in his own specialty. Whereas some men seek knowledge for its own sake, others are urged to research because of the practical importance of the knowledge sought for. But in the last analysis, all knowledge is of practical importance, the only difference being that some knowledge is more immediately practical than other knowledge. The solution of more or less practical problems in no way interferes with the development of any science, but rather hastens its development.

The clinician, on the other hand, must return to a study of the fundamental sciences for aid in the solution of his own problems. The fundamental sciences will furnish him, as in the past, with pertinent facts and accurate methods for investigation. Of the newer physiology and biochemistry he knows at present very little. Without this knowledge, a study of disease with its pathologic physiology suggests neither rational therapeutic measures nor problems for clinical investigation. In the past, bacteriology and pathology have been charged with the entire task of analyzing the cause of morbid processes and suggesting the cure—a task which these sciences alone obviously are incapable of performing. But with a deeper knowledge of all the fundamental sciences, including the physiologic group, the clinician will cease to spend much of his time at a description of what is present, helpful as it is in the diagnosis and differential diagnosis, but will begin to ask more often than at present why such signs and symptoms occur. The application of the methods of the physiologic group of sciences (biochemistry, physiology and pharmacology) to the problem will aid greatly in the final solution.

A close physical proximity of the laboratory and the clinic will be of great advantage to the laboratory worker and physician and eventually to the science of medicine. Besides engendering in both the clinician and the laboratory worker a mutual respect for the work of the other, joint conferences with a discussion of problems will suggest rational modes of attack in the clinic and laboratory at a time when the enthusiasm essential for the prosecution of any problem is at its height.

Summary.

As soon as the laboratory man, because of a more complete knowledge of the clinical branches of medicine, begins to appreciate the work and aspirations of the clinician, as soon as the clinician possesses a better knowledge of the fundamental sciences, then will both cease to avoid each other as bad medical company. With a common interest and a common knowledge, aided by detailed information of their own respective specialty, they will attack with vigor and effect problems of immediate practical moment. History reveals that medicine has evolved to its present status because of the work of both types of investigators. But the progress might have been faster had clinicians following the lead of Harvey and labora-

tory workers following the lead of Claude Bernard and others kept in sympathic touch with one another instead of cultivating a mental aloofness or critical attitude toward one another. As a result of concerted action, scientific medicine will make more rapid strides, the education of our medical students will improve, the fundamental sciences will in turn develop at a more rapid rate—all of which will redound to the more certain control of disease and cure of the sick.

SODIUM HYPOCHLORITE.*

I—The Preparation of Concentrated Sodium Hypochlorite Solutions of Great Stability for Use in Food Factories, Milk Plants, etc.

By Harper F. Zoller,

Methods for the preparation of sodium hypochlorite are so numerous that it seems almost unnecessary to add one more to the richly laden literature. But the methods heretofore advanced have been of value only to the textile manufacturer. A specific hypochlorite solution was made for a special factory operation under a given set of working conditions. No method has been devised for the wholesale production of a stable hypochlorite solution which would be suitable for transportation or storage for use in other industries. This study of hypochlorite was undertaken for the express purpose of determining the true nature of hypochlorites in solution, their stabilty and activity, and of producing a method for their preparation in large or small quantities for industrial plants.

Our conceptions of the constitution and the physical and chemical behavior of hypochlorite have very materially changed in the last few years. Recently, there have been a few attempts to regulate the stability and bleaching properties of chlorinated alkali solutions by studying their alkalinity in an empirical fashion. Among these investigations are the observations of Higgins[1] that

*Reprinted from the *Journal of Industrial and Engineering Chemistry.*

[1] *J. Soc. Chem. Ind.*, *27*, 185 (1911).

alkalies stabilize sodium hypochlorite solutions and lower the velocity of bleaching, while neutral salts increase the bleaching rate and decrease the stability. Renewed interest in hypochlorites, especially the alkali hypochlorites, for bleaching purposes in the textile industry has been strongly manifested in England during the last decade. In the United States the pendulum seems to have swung in another direction; we have become deeply interested in hypochlorites as sterilizing agents and general disinfectants. Calcium hypochlorite, or chloride of lime, is much less used than formerly, principally because of the high lime carrying power and the sluggishness of its suspensions. Sodium hypochlorite is more effective, is simpler to handle, and will not leave a film of lime at any time through its use.

Many factories and plants engaged in the production of food products would use sodium hypochlorite as a sterilizing rinse for their equipment, provided large quantities of a uniformly stable quality could be made readily available. The present market price is prohibitive to a factory of any size.

A careful search into the merits of hypochlorites as sterilizing agents under conditions where organic matter was mainly absent, at once revealed their value, and a series of studies was undertaken to determine suitable methods of preparing the one logical hypochlorite (sodium) in large quantities. These studies led to a consideration of the practical stability of this substance under the conditions to which it would be subjected in food factories and elsewhere, as distinguished from the properties expected of it as a textile bleaching agent.

A method is here outlined which will enable the average factory to prepare its own effective disinfecting agent simply and cheaply. In subsequent papers the writer will take up the activity of sodium hypochlorite in the presence of organic matter and its relative bactericidal efficiency. The method described in this paper is based upon the hydrogen-ion control system of manufacture. The solution is heavily buffered in order that the reaction of the solution will not rapidly change to yield an unstable solution. A sodium hypochlorite solution containing 5 per cent. available chlorine is here considered to be a concentrated solution. Solutions containing 10 and even 15 per cent. available chlorine are readily prepared using the same principle, but they are unwieldy and impractical for general use.

Stability of Sodium Hypochlorite.

The first successful attempts to prepare stable, dilute hypochlorite solutions for purposes other than bleaching were those of Dakin[2], and Cullen and Austin[3]. These attempts matured in the introduction of a serviceable antiseptic solution for medicinal and similar uses. But, owing to difficulties co-existent with the transportation and application of the Carrel-Dakin solution, a series of chloramines was developed which has in a measure superseded the Dakin solution.

Cullen and Austin found that between pH 9 and 10, Dakin's solution is very staple. This solution of sodium hypochlorite approximates a 0.44 per cent. solution of available chlorine, or a 0.45 per cent. solution of sodium hypochlorite.

Many attempts by others to prepare more concentrated solutions of sodium hypochlorite at a supposedly similar range of hydrogen-ion concentration (pH 9 to 10) have met with failure, the reason being, in the writer's estimation, a poorly buffered solution at the concentration sought. It is absolutely essential that the solution be heavily buffered between these limits of pH if a high concentration of hypochlorite is desired.

The methods in general use for the preparation of sodium hypochlorite are:

(a) Double decomposition of calcium hypochlorite (chloride of lime) with sodium carbonate or sodium sulfate.

(b) Electrolysis of sodium chloride with the production of sodium hypochlorite and hydrogen.

(c) Direct chlorination of sodium carbonate with chlorine gas.

Wherever large quantities of sodium hypochlorite are demanded, the first process is undesirable because of the variable character of commercial chloride of lime, and because of the large mass of residual calcium carbonate sludge which must be disposed of. In the electrolytic method it would be necessary to employ buffers along with the sodium chloride if a strong solution of sodium hypochlorite were desired; otherwise, it would be extremely unstable and the tax on the electrodes and equipment enormous. The direct

[2] Dakin, *Brit. Med. J.*, II, 318, 1915; Dakin and Dunham, "Handbook of Disinfectant."

[3] Cullen and Austin, *J. Biol. Chem.*, 34, 553 (1918).

chlorination method is the most practical one for universal practice of producing strong sodium hypochlorite solutions. It is the most easily controlled and can be made rapidly on a commercial scale.

In adopting the direct chlorination method of manufacture, the first step was to provide a solution with sufficient buffer material to hold the hydrogen-ion concentration in the region of pH 10 to 10.5. On the assumption that the zone of reaction required for the stability of Dakin's solution was applicable to stronger solutions of sodium hypochlorite, several preparations of 2, 3, 3.5, 5, and 10 per cent. available chlorine were made and studied in regard to their stability. The results of the study showed that for maximum stability these strong solutions required that powdered phenolphthalein spread on their surfaces should show a faint but distinctly red color, and further, that a 1 per cent. alcoholic solution of thymolphthalein should show a flash of blue color. When such a solution is analyzed for titrable alkalinity, available chlorine, and total chlorides, and calculations of the true hydrogen-ion concentration are made therefrom according to the scheme suggested by Cullen, one finds that the reaction is in the region of pH 10 to 10.6. This is a higher pH than is desired for Dakin's solution. The quality and quantities of buffer materials used for the purpose of furnishing the necessary reserve alkalinity follow later in the section devoted to the specifications for the hypochlorite preparation.

The following table is compiled from a great mass of trial runs made to determine the correct qualities of alkalies and pH for optimum stability:

TABLE I.

60% Caustic Ash %	Anhydrous Soda Ash %	Available Chlorine %	Approximate pH, Calcd. when Freshly Made	Pink to Phenolphthalein (Powdered)	Blue Flash Thymolphthalein, Alcoholic 1%	Available Chlorine after 10 Days %
5	5	3.15	8.5	No	No	1.72
5	5	3.03	9.0	No	No	2.10
5	5	4.22	7.8	No	No	0.70
5	7.5	3.20	8.8	No	No	2.04
5	2.5	2.53	9.8	Yes	No	2.28
5	2.5	2.30	10.2	Yes	Yes	2.29
5	2.5	2.20	10.8	Yes	Yes	2.20

60% Caustic Ash %	Anhydrous Soda Ash %	Available Chlorine %	Approximate pH, Calcd. when Freshly Made	Pink to Phenolphthalein (Powdered)	Blue Flash Thymolphthalein, Alcoholic 1%	Available Chlorine after 10 Days %
5	5	2.50	9.8	Yes	No	2.45
2.5	2.5	2.00	9.0	No	No	1.20
2.5	2.5	1.65	9.8	Yes	Faint	1.58
2.5	2.5	1.50	10.4	Yes	Yes	1.51
7.5	5	4.05	9.4	Yes	No	3.40
7.5	5	3.50	10.5	Yes	Yes	3.48
7.5	2.5	3.30	10.2	Yes	Yes	3.30
7.5	2.5	3.20	10.6	Yes	Yes	3.20
12.5	2.5	6.50	9.8	Yes	No	6.29
12.5	2.5	6.00	10.2	Yes	Yes	6.00
10	2.5	5.00	9.5	Yes	No	4.80
10	2.5	4.50	10.0	Yes	Yes	4.51
10	5	5.00	10.0	Yes	Yes	4.96
5	0	2.05	(?)	No	No	0.12
5	0	1.50	(?)	Yes	Yes	1.10

While all the buffer materials were serviceable, sodium carbonate, because of its availability and cheapness, proved superior. As far as could be estimated, there was no appreciable anion influence on the stability of the concentrated solutions among the above buffers. The criterion of the stability seemed to be the intensity of the alkalinity, which is here characterized as the hydrogen-ion concentration.

60% Caustic Ash %	Buffer	% Buffer on Moisture-Free Basis	Pink to Powdered Phenolphthalein	Blue Flash to 1% Thymolphthalein	Available Chlorine Fresh %	Available Chlorine 30 Days Later %
7.5	Na_2CO_3	2.5	Yes	Yes	3.25	3.25
7.5	Na_3PO_4	2.5	Yes	Yes	3.19	3.17
7.5	$Na_2B_4O_7$	2.5	Yes	(?)	3.20	3.21
7.5	Na_2SiO_3	2.5	Yes	Yes	3.22	3.22
7.5	$NaHCO_3$	2.5	No	No	3.25	2.80

The influence of daylight on the stability is only minor. The use of amber-colored bottles is unnecessary. In ordinary clear glass bottles the hypochlorite solutions keep for five or six months with less than 10 per cent. loss in available chlorine.

It is not necessary either to cool the alkali solutions below 40° C. while chlorinating them, or to store the resulting hypo-

chlorite in a cold place. Whereas it is true that the activity of the hypochlorite solutions (chlorinating power) is accelerated by small increases in temperature, their internal decomposition is not noticeably accelerated at the stable region in pH 10 to 10.5.

Quantitative Aspects of the Chlorine-Gas Method.

When chlorine gas is passed into a mixed solution of sodium hydroxide and sodium carbonate, containing about 10 and 2.5 per cent., respectively, and the gas is stopped when the solution registers 5 per cent. of available chlorine, it is found that the yield is 99 to 100 per cent. A temperature change from 15° to 40° C. does not affect this yield. There is no formation of either chlorate of perchlorate under these conditions, or, if there is a chance formation of one or both, they must revert immediately to the hypochlorite, since the chlorine is found in the available condition in the solution. As a matter of fact, when the sodium hypochlorite solution is titrated for the available chlorine concentration, with sodium thiosulfate and sodium iodide in acid solution, actually two equivalents are titrated for every mol (70.9 grams) of chlorine gas passed into the alkaline solution. It matters not whether these equivalents come from the bound oxygen or bound chlorine in the hypochlorite molecule, so long as experience shows that the complete activity of the hypochlorite solution is *not destroyed before it registers zero available chlorine.*

In actual experience a pure sodium hypochlorite solution at pH 8 begins to lose free oxygen to the air. The higher the temperature at this pH the more rapid is the decomposition. Coincident with this loss of oxygen the solution becomes more acrid, and because of the increased acidity the decomposition is again hastened. It is an example of catalysis augmented by the hydrogen ion.

Whether or not it is the chlorine or the oxygen, or both, which are the active constituents of sodium hypochlorite, for every pound of chlorine used, one pound (100 per cent.) of available chlorine is obtained in the product.

Preparation of Sodium Hypochlorite.

UNCHLORINATED SOLUTION—It was found desirable to use sodium hydroxide of good technical grade (60 per cent. caustic ash) for chlorinating, and a good grade of soda ash (anhydrous sodium

carbonate) for the buffer material. In order to make a solution of sodium hypochlorite of certain strength, a definite amount of alkali in the presence of the buffer will be required to maintain the stable point in pH. A stronger solution will require more alkali. The writer has made several thousand gallons of 2.5 to 5 per cent. sodium hypochlorite during the last two years, and has found it desirable to maintain the concentration of sodium carbonate at the same point in all the formulas—*viz.*, 2.5 per cent.

TABLE II—SHOWING RELATIVE AMOUNTS OF ALKALI AND ALKALI CARBONATE FOR DIFFERENT CONCENTRATIONS OF PRODUCT.

NaOH (60% Free Alkali)	Na_2CO_3 (Anhydrous Soda Ash)	Average Chlorine for Stable Product	pH (Approx.)
%	%	%	%
2.5	2.5	1.4	10.0
5.0	2.5	2.25	10.8
7.5	2.5	3.25	10.5
10.0	2.5	4.50	10.5
12.5	2.5	6.25	10.6

For 5 to 25-gallon quantities of hypochlorite, the alkali and soda ash are weighed into an iron or copper bucket, and about one-third to one-half of the water is added and the whole stirred until dissolved. It is then filtered through layers of absorbent cotton or muslin into the chlorinating receptacle, which should contain the remainder of the water.

CHLORINATION—The chlorine is led from a commercial drum through a copper tube fitted with a brass or bronze needle valve, and silver soldered thereto. The copper tube may be made to fit snugly into the valve head on the chlorine drum and clamped there under pressure. The copper tube from the needle valve terminates into a gas meter, which is chlorine-tight. The meter may be either of the dump type or Venturi effect. Both have been used with success. They must be made entirely of glass and filled with a non-freezing, nonchlorine-attacking solution such as an alkali chloride brine (NaCl). If rubber connections are used they will have to be frequently replaced. A chlorine distributor for immersion into the alkali solution may be made from a coarse alundum thimble and glass tube. Similar diffusers are already on the market. By aid of

the needle valve the stream of chlorine gas can be easily regulated. For large-quantity production the chlorine meter may be dispensed with, but it is then necessary to follow the rate of chlorination by titration.

CONTROL OF STRENGTH OF HYPOCHLORITE—It is only necessary to know the quantity of chlorine passing into the alkali during a given time interval to calculate the strength in terms of available chlorine. However, it is often more convenient to have available a 0.1*N* sodium thiosulfate solution for the purpose of direct determination of the available chlorine content. The method used in this laboratory is to measure 10 cc. of distilled water, 5 cc. of glacial acetic acid, and 5 cc. of 5 per cent. sodium iodide into a Erlenmeyer flask. Exactly 2 cc. of the hypochlorite solution are added, and the liberated iodine is titrated directly with the thiosulfate to the disappearance of the yellow color. No starch paste is necessary, although a white paper background is convenient.

The number of cubic centimeters of 0.1*N* sodium thiosulfate required for the 2 cc. of chlorinated solution, multiplied by the factor 0.1772, will give the percentage of available chlorine in the sodium hypochlorite. The percentage of available chlorine multiplied by 1.05 is the percentage of sodium hypochlorite in the solution. It is very essential that the difference between the concentration of available chlorine and concentration of sodium hypochlorite be specifically stated. The two are often intermingled.

Relative Costs of Production.

The overhead expense of this method of manufacture is very low. Soda ash and caustic soda are relatively cheap—the former is around 2 cents per pound, and the latter about 4 cents per pound. Drum chlorine is quoted at 7 to 10 cents per pound. Thus, if we allow 50 per cent. for labor costs, the expense of producing 2.5 to 5 per cent. "available chlorine" sodium hypochlorite amounts to approximately 6.80 cents and 16.22 cents per gallon, respectively. These values are in a market contrast with the price of some of the commercial sodium hypochlorite preparations now on the market.

Laboratories of the Uizer Company, Detroit, Mich.

SOLID EXTRACTS

Human perspiration contains a considerable amount of citric acid, which is the main organic acid of the lemon, Dr. Chauncey D. Leake, of the laboratory of pharmacology and physiology in the University of Wisconsin, has discovered. He found that in the daily sweat of an average-sized individual there is about a grain and a half of this interesting acid. More interesting, however, would be to know how one arrives at a computation of the volume of the daily sweat of the individual. For instance, how much like a summer drink must be the epidermal ooze of an editor.

Excessive use of tobacco, high protein diet, and infected teeth and tonsils, long associated with the existence of high blood pressure, have been largely cleared of responsibility for that condition by a recent joint study of the Life Extension Institute and the Metropolitan Life Insurance Company. Overweight, however, has been found to be consistently accompanied by a larger number of cases of high blood pressure in the examinations of 17,000 policy holders of the insurance company.

Though the tobacco smoke in a room may be so thick that it blinds the eyes, there is little danger that the carbon monoxide, a deadly gas often produced by incomplete combustion, that it contains will harm the smoker. The U. S. Bureau of Mines here has officially announced that three of its employees smoked and inhaled all sorts of cigarettes and cigars in a tightly closed test chamber and determinations showed that not more than one hundredth of one per cent. of carbon monoxide was present in the air.

The story of a man who was so sensitive to certain foods, especially eggs, that he could eat the meat of a rooster but not that of a hen, unless the animal were drawn immediately after killing, was related to members of the American Medical Association in their recent convention. The narrator was Dr. W. W. Duke, of Kansas City, who stated that in his experience such unusual sensitiveness was often hereditary. Sea foods were said to cause the condition more often than fruits, vegetables, or commonly eaten meats.

Tuba root seems to have been used for an insecticide first by Chinese market gardeners, who macerated the root with water and sprayed their plants with the resulting milky fluid, thereby following the lead of the natives who painted this same fluid on their arrows to poison them.

The arrow poison is now used in proprietary insecticides and the demand for it on the English market is steadily increasing.

The Mulford exploration party state that a primitive means of wireless communication had been in use among certain tribes of natives of South America long before the radio was thought of.

The drum which the natives use for broadcasting is a magnificent thing, a huge cylinder carved and hollowed out of a single trunk of hard wood. When in use, it is slung in a cradle so as to give the greatest possible freedom for vibration. The Indians claimed that it could be heard a distance of four days journey up the river. The Mulford party had the drummer signal to the tribes up the river, announcing the coming of the white men and were able to verify later that the message carried a long distance and had been properly interpreted by Indians located there.

The spleen is a useful but not essential organ, Dr. Charles Richet has reported to the Paris Academy of Sciences. Its purpose and functions seem to be connected with the general processes of nutrition. Animals whose spleens have been removed can survive for long periods, but they require more food to keep up their normal weight, and die more quickly than normal animals when starved. The spleen might thus be said to stave off starvation.

During the fourteenth century love philtres were the vogue and alchemists left their search for the quintessence for the more lucrative labor of concocting "inspiring potions." They were composed of various ingredients in use at the time and were in the form of powders or liquids. The entrails of animals, feathers of birds, parings of nails, the scales of fishes, powdered loadstones and human blood were then used in love philtres. Hairs from a wolf's tail, the bones of the left side of a toad that had been eaten by ants, the blood of pigeons, skeletons of snakes and other equally disgusting things were used as ingredients in Roman love philtres.

The Journal of the American Medical Association declares rejuvenation unproved. It states that there is in support of this theory "only a mass of poorly supported, uncontrolled clinical evidence and some laboratory evidence not bearing directly on the point concerned. Certainly there is not as yet any actual proof that rejuvenation has been accomplished in a single individual, or any basis for the belief that it ever will be accomplished."

China remains faithful to many of the medicines which were in vogue when Confucius walked in the land. Despite the march of medical science, a poultice of rice well mixed with crabs' eyes is still considered efficacious by many native doctors who are consulted for earache troubles. Crabs' eyes, spread on a sore are supposed to assist in the healing process, and carbuncles are said to yield to their powers of persuasion. Ground coral, seasoned with chopped sea-slug, is considered an unrivalled digestive. Strange, too, is the cure for baldness. It consists of black cats' flesh, grilled to a cinder and smeared with a particularly evil-smelling ointment. The dainty must be eaten first thing in the morning, a process, we would say, that qualifies as a "hair raiser" not only in Chinese, but in every other language.

Sodium - dihydrogen - phosphate is stated to afford a most remarkable result in the increase of muscular

power and endurance. During the war a German scientist conducting a series of tests furnished this chemical to the shock troops as they entered battle or during long marches in the form of a flavored drink. To avoid the influence of psychological suggestion, other battalions were served with a sham drink sweetened and flavored the same, but acidulated with tartaric instead of phosphoric acid. At the end of a hard, hot day the troops that had been treated with the phosphate were fresher in spirit and less fatigued in body than the others for some reason mysterious to them.

This new stimulant, the sodium-phosphate of the drugstore, has the advantage over alcohol or the alkaloids in that it is a natural factor in bodily process, and also in that there is no danger of intoxication from an overdose or of forming a habit. Doses up to a quarter of an ounce a day were given to the soldiers. More than this, and for some people much less than this, has a laxative effect.

Soya bean sauce, now becoming popular in America, has long been a household commodity with the Orientals. Thousands of years ago the Chinese used it to flavor their rice. It is made by fermentation and the flavor depends upon the way it is brewed and the length of time it is left to ripen. To suit the palate of a Korean connoisseur the jars must be exposed to the sunshine by day and covered by night for a period of thirty years. We Americans, when we get to making it, will undoubtedly speed up the process.

SCIENTIFIC AND TECHNICAL ABSTRACTS

Poisoning By Barium Sulphide.—Several cases of this type of poisoning have been reported. The *Schweiz. Apot. Zeit.* (1923, v. 61, 353), reports a recent case and gives details of two others. They were fatal and were due to mistaking orders for barium sulphate. Inasmuch as the sulphide is now largely used as a depilatory, druggists keep it on hand and dispense it freely. In each of the accidents barium sulphate had been prescribed for use in X-ray examinations of the stomach and the substance furnished was freely administered. Prompt action as an irritant at once developed, indicated by gastric pain, vomiting and purging, with death in a few hours. Not only does the sulphide act as a local irritant but as is well known, soluble barium salts are highly toxic, so that a doubly poisonous action results. It would seem that the

odor of the sulphide when mixed with water would prevent mistake, and in one case the nurse preparing the material called attention to this fact, but was told that it was all right, being what the doctor had ordered. The mistake is, of course, due to the similarity in the names, which is noted in German as well as in English. In German the terms are respectively "sulfuratum" and "sulfuricum." On account of the danger of confusion it might be well for doctors and druggists to agree on some method of positive distinction. Perhaps the addition to every prescription of barium sulphate the words "for internal use" might secure safety. In all cases the word "sulphate" should be written in full.

H. L.

STUDIES IN HORSE BLOOD.—C. P. Neser, D. Sc., Pretoria, gives in the *So. Afr. Jour. Sci.* (1922, xix, 244), the results of studies of the blood of horses. The counts of erythrocytes and leucocytes were made upon animals under very different conditions of exercise. The uniform results were that the erythrocytes are much increased by active exercise, while leucocyte counts are not materially changed, except in jugular blood. Care is required in taking the sample or misleading data will be obtained. Comparison was made between stabled horses and those of the same breed on active work. Two animals kept under examination for a long time, one a riding horse in active use and the other stabled, showed for the former a count of about 9 millions per cub. mm., but the latter averaging 5½ millions. Some race horses gave about 10 millions. Diurnal variations in counts were noted, but were found to be unconnected with either diet or ingestion of water. When at the same time blood is taken from the jugular and ear the latter is almost always found to give a higher figure for erythrocytes. These counts diverge most during digestion or rest, but if the horse is excited the figures converge. Neser was able to bring about a close agreement in ten minutes by threatening the horse. It will be seen that the range in horse blood in presumed health is much greater than in man.

H. L.

ANETHOL FROM NEW SOURCE.—A new gum-resin of interesting possibilities has been investigated by the Imperial Institute of Sci-

ence and Industry of Australia. This product, called Gum Nauli, is obtained from a large tree growing abundantly in the Solomon Islands and is of a pale yellow color, smelling strongly of anise.

Analysis shows it to consist mainly of resin, 81.8 per cent., but it also contains something over 10 per cent. of a volatile oil which shows approximately 34 per cent. of anethol. The oil is obtained by distilling the gum-resin with steam and anethol is readily obtained from it in the usual way. As a source for anethol this oil can hardly compete with oil anise at the prices prevailing for the latter, but the oil if sufficiently cheap might be of interest for soap perfuming and other purposes.—*Ungerer's Bulletin.*

MENTHOL EMULSIONS.—Although to all intents and purposes menthol is insoluble in water even in the presence of a considerable proportion of alcohol, it is none the less possible to make aqueous preparations containing sufficient menthol to give them therapeutical value.

This is accomplished by the employment of an emulsifying agent, one of the best of which for this purpose is the tincture made from *Quillaia saponaria* (Panama wood) and well known to the pharmacist.

A weak emulsion is made by dissolving three to five centigrams of menthol in five grams of tincture of *Quillaia,* then adding ten grams of glycerine and adding enough water to make a total volume of 125 cubic centimeters. The water must be added in small portions with thorough agitation. The resultant emulsion, or semi-solution, is light amber in color and holds the menthol in permanent solution.

For exterior applications, a stronger preparation can be compounded, using fifteen to thirty centigrams of menthol, ten cubic centimeters of tincture of *Quillaia* and sufficient water to make 155 cubic centimeters. This is applied by means of cold compresses alternating the treatment every few minutes with cloths soaked in cold water.—*Ungerer's Bulletin.*

PENETRATIVE POWERS OF ARSENICALS.—The U. S. Public Health Service reports in a recent bulletin that investigations made under the auspices of the service by Carl Voegtlein, M. I. Smith,

Helen Dyer and I. W. Thomson indicate that the frequent failure of the common antisyphilitic arsenicals (arsphenamin, neoarsphenamin and silver asphenamin) is due to lack of power to penetrate the tissues in amounts sufficient to destroy all the parasites, and that some of the other arsenicals having superior powers should be used. The report was made after extended experiments, chemical and bacteriologic, on rabbits. It is recognized that the results are not directly applicable to the problems of human syphilis, but they indicate that clinical trial of the more powerful preparations should be made. The experiments emphasize Ehrlich's view that better results are obtained by heroic doses a week apart than by divided doses at shorter intervals.

H. L.

BOOK REVIEWS

DARSTELLUNG UND NACHWEISE TIERISCHER GIFTE. By Edwin Stanton Faust. 8 vo., 176 pages and index. Urban & Schwarzenberg, Berlin and Vienna. Swiss francs, 8.1, in paper.

This is the 97th fasciculus of Abderhalden's Handbook of Biologic Procedures, covering pages 752 to 928 of the series, being part of Section 4, devoted to chemical and physiologic methods. It is a very comprehensive study of the nature and methods of analysis of the peculiar poisons which are secreted in many animals and which are often exceedingly powerful. Our knowledge of the subject is unfortunately far from complete; in fact, it may be said that we are just beginning to know how wide the field is. In discussing the subject certain questions arise, among which is as to what constitutes a poison. Almost anything is a poison if taken in large amount; scarcely anything if taken in very minute amount. How far shall the element of time be allowed to enter into the determination? Some substances that are in familiar use, such as coffee, tea and chocolate, may have a tendency to injure health and shorten life, yet they have never been classed as poisons. Tobacco is certainly nearer the poison line and alcohol must be considered as within it. On the other hand,

no one would object to the classification of strychnin as a poison, yet small doses of it may be taken daily for many years without appreciable objectionable effect.

The difficulties in investigating animal poisons are much greater than with those of plants. Specimens of plants are easily obtained in quantity, and in most cases prompt analysis is not required, but true animal poisons are costly and troublesome to obtain and prompt examination is necessary. The transportation of plant specimens from distant lands to the laboratory is usually easy and safe, but animals must either be examined on the spot or be brought alive to the place of test. Very soon after the death of an animal all its tissues and fluids begin to decompose, and new poisonous substances having no connection with the original secretions develop. The author of the book recognizes the difficulty of defining the term poison. He holds that the characteristic of a poison is that it produces disturbance of function by chemical or physico-chemical means, and he asserts that the toxicity of a given substance is solely dependent on a quantitative relation.

It is also difficult to determine whether a given animal is or is not venomous. When the animal has a distinct specific organ, the secretion of which is available for injury to its enemies, obviously there will be no dispute. Many animals are known, however, that secrete poisonous fluids, yet have no way to make use of them. The common toad exudes from its skin glands an irritating fluid, yet can make no use of the function for offense or defense. Certain snakes, though destitute of specific poison fangs, have glands that secrete poisonous substances which are also found in the blood. Faust, therefore, terms these two classes of toxicity, respectively, "active" and "passive." The first type is well exemplified in the venomous snakes; the passive form in cantharides and poisonous plants. Even this classification does not eliminate the difficulty, and it seems that a precise definition of a "poison," and even of a "poisonous organism" must be left for further discussion.

Obviously, an animal poison is one which is produced by specific secretion in the animal through organs adapted to the purpose. All secondary products such as may arise from micro-organisms or pathologic conditions must be excluded. The saliva of many animals may act as a poison, but in most cases this is due to the organisms which have developed in the mouth. Sternberg showed many

years ago that human saliva may kill a rabbit, and cases in which a human being has bitten another in a quarrel have not infrequently evidenced serious infection. The toxic ingredients in anthrax, glanders and rabies are not the result of normal physiologic processes. The toxic effects of incipient decompositions of animal tissues have been long known, and although extensively investigated, much still remains to be explained. Often the earliest changes, not readily appreciable to taste or smell, give rise to more violent effects than the more advanced conditions. Meat and milk products are often eaten without injury when in a notably decomposed condition, such as "high" game and Limburg cheese. A cream puff a day old may bring an adult near death, although no evidence of decomposition is indicated. It is also possible that animals in conditions of disease may acquire poisons through pathologic processes not connected with the action of micro-organisms. The term "ptomain" poisoning, originally introduced to designate the action of substances found in decaying animal tissues, has become a newspaper slogan, and any sudden illness following a meal is diagnosed as such. Selmi, who coined the word "ptomain" from the Greek "ptoma," "corpse," was a better chemist than classicist, for the word should have been derived from one of the oblique cases and read "ptomatin."

The descriptions of the book in hand follow the zoological classification. This is the only method available at present. Classification by composition or by pharmacologic data is impossible, owing to the limited amount of exact information at hand. After all, the book is a manual for the worker either in research or in forensic problems, and the arrangement is of little importance if a good index is at hand. Such an index is not in the volume before us, but a comprehensive table of contents is given, and the classification by zoological relations will facilitate reference. The first group, "Mammalia," has not yielded many specific poisons. A remarkable instance is in that very remarkable mammal that lays eggs and nurses the young, the duck-billed platypus *(Ornithorhyncus paradoxus.)* It is the only mammal that has a specific poison apparatus. The male has on each hind foot a channeled spur that is connected by a duct (5 cm. long) to a sack in the femoral region. The venom has been investigated by several pathologists and chemists, but the exact nature is not yet determined. It does not seem to be fatal to human beings, although considerable pain and physiologic disturbance may

be caused. The poison is considered analogous to those in the venomous snakes of Australia, but far less toxic.

Faust has given in this book a very valuable collection of data on a most important department of toxicology. The arrangement, type, printing and the elaborate bibliography (in which the year as well as the volume are given in journal references and the year of issue in the case of books), all conduce to making the work a highly acceptable addition to the library of toxicologist and pharmacologist.

HENRY LEFFMANN.

PHYSIOLOGISCHE WERTBESTIMMUNG VON GIFTEN UND GIFTKOMBINATIONEN AN WARMBLUETERN UND DEREN ORGANEN. By W. Storm van Leeuwen, of Leyden.

METHODEN BEIM ARBEITEN MIT SENSIBILISIERENDEN FLUORESZIERENDEN STOFFEN. By Herman von Tappeiner, of Munich.

DER NACHWEIS PHOTODYNAMISCHER WIRKUNGEN FLUORESZIERENDER STOFFE AM LEBENDEN WARMBLUETER. By Hermann Pfeiffer, of Graz.

These essays are included in Fasciculus 98 of Abderhalden's Handbuch der biologische Arbeitsmethoden, being number 5, part 7, of the fourth section of Applied Chemical and Physiologic Methods. The copy in hand is in paper, octavo size, 173 pages, covering the portion of the volume from 929 to 1102, 8.1 Swiss fr.

The vastness of the work is indicated by these figures and its excellence is apparent on examination. Numerous illustrations, graphs and tables are given. Of the three essays, that on the physiologic valuation of poisons, is by far the most extensive, covering 141 pages. The essay on methods of employing fluorescing substances is completed in 12 pages and the remainder (20) pages is devoted to a study of some of the effects of fluorescent substances on warm-blooded animals.

The information offered in this volume is so very intricate and highly specialized that it is difficult to present a satisfactory review of it. Being merely a publication in course there is no table of contents or index. These will follow when the section is complete and will be comprehensive and full. Physiologic methods of testing

for poisons have been long in vogue, but it is comparatively recently that they have been carefully examined and the conditions of accuracy and certainty ascertained. In the extensive essay by van Leeuwen it is pointed out that physiologic methods find special application in three conditions In the first place, many poisonous materials are still incompletely analyzed, the essential principles not being chemically indicated. An example of this is ergot. V. Leeuwen has found that samples may differ greatly, some being as much as thirty times stronger than others. Digitalis leaves offer much the same problem. Physiologic methods are advantageous when a drug contains a number of substances more or less active, and subject to variation in the proportions of these. Opium, for example, is usually graded according to the content of the principal alkaloid. A table of determinations of the alkaloids in samples of opium from different sources is given to show that the morphin content has no definite relation to that of the others.

Physiologic testing is also advisable when a new remedy is introduced or the manufacture of a remedy assigned to an establishment not previously engaged in the work. Physiologic methods have also been extensively applied in the study of the effects of adulterants and substitutes in food. Of course the greater part of physiologic testing is carried out on the lower animals, but some rather comprehensive experiments have been made on groups of human beings. It must be admitted, however, that the "poison-squad" methods have not been by any means always decisive.

Experiments on the lower animals have several important drawbacks. The symptoms are entirely objective. No information can be obtained as to the sensations of the animal except as shown by conduct or cries. It is true that with human beings disturbing psychologic phenomena interfere. Many years ago some experiments of the effects of alcohol were published. The subject, reclining on a couch, was told that dilute alcohol was given. There was an immediate though slight increase of pulse, yet the liquid was pure water. Imagination had had an effect. Von Leeuwen records some experiments of his own, in which cats were used to value a digitalis infusion by Hatcher's method. Three animals gave respectively, 2, 2.1 and 2.18. These figures are satisfactorily accordant, but a fourth animal gave 3.1, about 50 per cent. higher than the largest number obtained in the other experiments. No explanation of this

was available. In this relation chemistry stands more precise and uniform. Litmus will turn red with acid, though it be tested many times, but a minute dose of nicotin administered to cats may give in twenty experiments practically the same increase of blood pressure and in the twenty-first trial no increase, indeed, may give a decrease. Methods of carrying out the most elaborate investigations in this line are given in the article.

One turns with a good deal of interest and expectation to the second essay, on the employment of sensitizing fluorescent substances. Fluorescence is explained in the current terminology of optics, as due to an increase of wave length. It is shown by many substances, though by only few in a high degree. Several of the synthetic dyes have been extensively employed to increase the sensitiveness of photographic emulsions. The phenomenon is especially startling and brilliant when ultra-violet light is employed, as the rays are invisible until they meet the fluorescent substance. Although these dyes increase the sensitiveness of silver salts a reverse effect is produced on many living cells and on some poisonous principles. Protozoa, molds and yeasts are very sensitive, as are some toxins, *e. g.*, those of diphtheria and tetanus, while snake venom is far more resistant. Enzyms exhibit differences. Invertase and diastase are quickly rendered inert, but the oxydizing catalysts are much less affected. The author (v. Tappeiner) of the essay regards the action of the substances as practically oxidations. The phenomena are collectively termed "photodynamic." No particular relation has so far been found between the action of ultra-violet light in itself and fluorescence. It is well known that ultra-violet rays are highly injurious to living cells. Blindness may result from even brief exposure and bacteria are promptly killed. In studying these effects of fluorescence diffuse daylight may be used when the organisms are very sensitive, but sunshine or electric light is often required. Special apparatus for producing ultra-violet light is now available, but its injurious action on living cells must be borne in mind. Infra-red light must be excluded. It has a curious interfering effect. The essay gives an ingenious method of directing the rays upon the organisms. The latter are placed in a glass vessel with upright sides (the common crystallizing dish) and a horizontal beam from an arc lamp is bent to the vertical by means of a magnalium mirror. It has been found that this alloy (of magnesium and

aluminum) reflects the rapid rays better than most other surfaces. Some experiment with *Paramecium caudatum* are detailed which are striking. One of the complicated anthracene derivatives was used. By some oversight the table of results is headed "sodium dichloranthracene 2-7 disulfonate, but in the subsequent comment the action is ascribed to the acid. Comparative results are given with solutions of equal strength exposed to strong diffuse daylight and in darkness. Even in very dilute solution the fluorescent substance has a powerful action, not only killing but disorganizing the animal. A concentration of 1/1000 was found to be more active than those above or below this. That fluorescence is often stronger in dilute solutions is a common observation. The concentration of 1/1000 killed the organism in ten minutes, while it lived for forty-eight hours in the same solution in darkness. Many data of similar nature are given.

The last essay by Pfeiffer presents data of much more complicated nature, being details of effects of the introduction of fluorescent substances into the bodies of warm-blooded animals. Even some experiments on human beings are noted, it being reported that the introduction of 0.2 gram of eosin and exposure for twenty minutes to a strong light will temporarily double the total nitrogen output of the urine. The cause of these peculiar effects is not yet ascertained. It is a mere speculation that if the generally accepted theory of fluorescence is true, namely, that there is an increase of wave length, the injurious action may be due to removal from the incident light of some of the rays that are essential, yet the fact that *Paramecium* lives so long in the dark is not in accordance with this view. It seems as if the progress of modern science results only in giving the world more problems. It might be said that our knowledge increases at an arithmetical ratio and the new problems at a geometrical ratio.

"Hills peep o'er hills and Alps on Alps arise."

It is hardly necessary to pass an encomium on Abderhalden's "Handbuch." All the portions are written by specialists and are indispensable to the laboratory worker.

HENRY LEFFMANN.

ANLEITUNG ZUM CHEMISCHEN NACHWEIS DER GIFTE. By Dr. Th. Sabalitschka. 8 vo., vii-120 pages, index and 7 illustrations. Printed in Austria. Urban and Schwarzenberg, Berlin and Vienna. 4.5 Swiss francs.

The word "toxicology" harks back to a remote period when the human race employed the bow and arrow. The derivation is from a Greek word meaning "bow." Arrows were doubtless poisoned with plant and animal materials in order to increase the virulence of the wound. Modern toxicology may be said to have become a science by the publication of Orfila's book, since which a large amount of literature has accumulated, and investigations of cases of poisoning have been transferred almost entirely to the chemical laboratory. Physiologic methods have, however, been extending in application and one of the recently issued fasciculi of Abderhalden's "Handbuch" is devoted to setting forth these methods. For many poisons the chemical methods are amply sufficient, being delicate and certain. The work in hand is described as intended for "pharmacists, chemists and physicians," and leans, therefore, almost entirely to the chemical side. It is a compact and rather comprehensive manual in which the standard and well-known tests are set forth. In many cases the formula of the reaction involved in the test is given. Thus, in connection with Lieben's test for ethyl alcohol, the complex changes are given in detail. This seems to the reviewer a waste of space and an unnecessary expense. Persons should not undertake responsible analyses until sufficiently prepared in chemistry to know the general nature of the actions taking place in their tests, when such actions are known. In many cases, such as the color test for strychnin, the nature of the change is not known. Dr. Sabalitschka follows the German custom of representing iodine by J. It is surely disappointing to note how a lot of petty nationalistic feelings interfere with unification of the terms and symbols of science. The French custom of writing exponents in chemical formulas as superiors, a practice now abandoned by all others; the German use of "benzol" for "benzene," the variations in the writing of the hydrogen-ion symbol and expressing wave length—sometimes in micro-microns and sometimes in Angstroem units—all these irregularities tend to burden scientific literature and increase the difficulties of teaching.

As might be expected the author discusses the definition of

"poison." Every writer on the subject makes the attempt and generally merely adds to the existing confusion. He states that an unobjectionable definition is not at present possible. Provisionally, he favors one that he ascribes to Lewin, which has been judicially approved in Austria. "Poisons are chemical, unorganized substances, or organisms that excrete chemical substances, that placed upon or in the human body give rise, under certain conditions, to illness or death." The definition can hardly stand the fire of skillful cross-examination. Powdered glass taken into the stomach may produce death, but the action is traumatism, not poisoning. A classification of poisons is also offered. This is another difficulty for the toxicologist, but it is self-imposed for there is little generic connection between poisons; it is just as satisfactory to the analyst to have the individual substances arranged alphabetically as in any other way. The methods of toxicologic analysis are classified in this book into four groups: substances that are volatile with steam when in acid solution; substances not volatile under this condition; metallic poisons; poisons that require special methods. By a typographical error on page 9 this schedule is stated to be in five divisions. The classification adopted under this schedule brings together substances of very different nature. This is, to be sure, no great objection, for the alphabetical system which would bring "bromine" and "brucine" together would make many strange associations. Preliminary tests are given which include the old blowpipe procedures and a few chemical ones. Reinsch's test is described in connection with general tests for the heavy metals. No statement is made as to the value of this for examining original materials, that is, stomach contents, foods, excretions and, in fact, almost any organic mixture, even when in a state of active decomposition. The copper and hydrochloric acid needed are now easily obtainable in pure form, and the method is such that a preliminary testing of the two substances can be (and should always be) made, after which a portion of the material may be added and the mixture reheated. The elaborate development of the principle of Marsh's test has diverted attention from the procedure of Reinsch, but the latter is delicate and exact. The book gives a detailed description of Marsh's test, but the arrangement of apparatus is rather old-fashioned,

The most serious side of toxicology, that is, the examination for poisons in criminal cases, is much more than chemistry. The symptoms are of great importance and routine examinations, similar

to those prescribed in the instruction of students in qualitative analysis are rarely applicable or required. The materials (food, medicines, viscera) usually come to the toxicologist with some general data which exclude many poisons, and narrow the search to some group with characteristic physiologic effects. The volume in hand contains a large amount of information and except as to introduction of many reactions in symbols, which do not seem to be necessary, the space is well used. The printing is good; the paper is somewhat more highly calendered than seems to be necessary for a work not illustrated with half tones, but this is a matter of opinion.

HENRY LEFFMANN.